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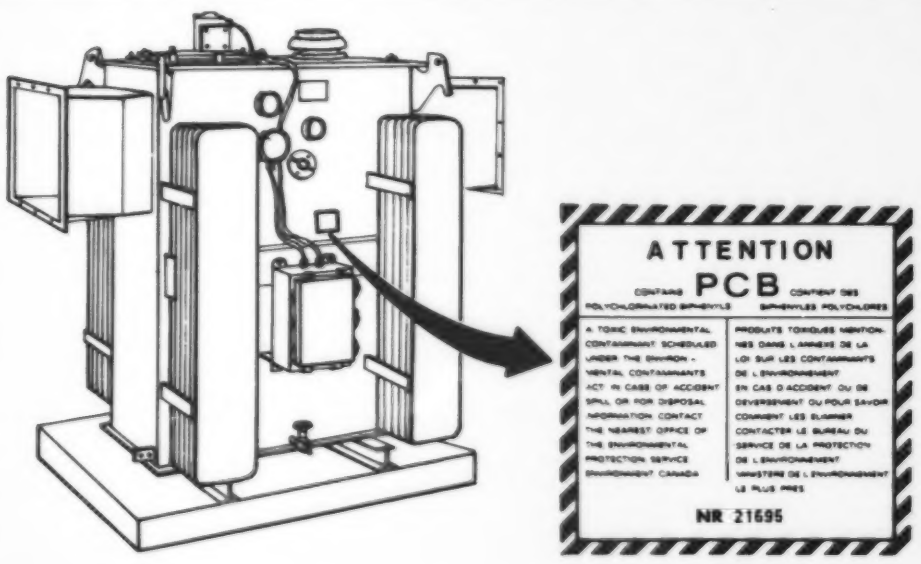
HANDBOOK ON PCBs IN ELECTRICAL EQUIPMENT


ATTENTION
CONTAINS PCB CONTIENT DES
POLYCHLORINATED BIPHENYLS BIPHENYLES POLYCHLORES
A TOXIC ENVIRONMENTAL CONTAMINANT SCHEDULED UNDER THE ENVIRONMENTAL CONTAMINANTS ACT IN CASE OF ACCIDENT SPILL OR FOR DISPOSAL INFORMATION CONTACT THE NEAREST OFFICE OF THE ENVIRONMENTAL PROTECTION SERVICE ENVIRONMENT CANADA
PRODUITS TOXIQUES MENTIONNES DANS L'ANNEXE DE LA LOI SUR LES CONTAMINANTS DE L'ENVIRONNEMENT EN CAS D'ACCIDENT OU DE DEVERSEMENT OU POUR SAVOIR COMMENT LES ELIMINER CONTACTER LE BUREAU OU SERVICE DE LA PROTECTION DE L'ENVIRONNEMENT MINISTERE DE L'ENVIRONNEMENT LE PLUS PRES
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HANDBOOK ON PCBs IN ELECTRICAL EQUIPMENT

Third Edition

Commercial Chemicals Branch
Conservation and Protection
Environment Canada

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FOREWORD

This handbook is primarily intended for owners and users of electrical equipment that was designed to contain polychlorinated biphenyls (PCBs). It provides background information on PCBs, including federal legislation that pertains to them and simple procedures for identifying equipment containing PCBs. Procedures and options for handling and controlling PCBs and PCB equipment are discussed, including preventive maintenance (Chapter 3), PCB substitutes (Chapter 4), containment systems (Chapter 5), preparation for storage (Chapter 6) and storage (Chapter 7). Any mention of trade names does not constitute endorsement by the authors or Environment Canada.

The first and second editions of this handbook were prepared by Environment Canada using information compiled by Stothert Engineering Limited of Vancouver, B.C. and M.M. Dillon Limited of London, Ontario. The third edition is based on a technical revision carried out by M.M. Dillon Limited under contract to Environment Canada.

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BACKGROUND

Polychlorinated biphenyls (PCBs) are man-made chemicals that were first synthesized in 1881, but not manufactured on a commercial scale until 1929. They can be liquids or solids, depending on the degree of chlorination (i.e., the number of chlorine atoms attached to the biphenyl molecule). PCBs are very stable, non-corrosive, relatively non-flammable, insoluble in water, soluble in fuel oils and chlorinated benzenes and, at ambient temperatures, have low vapour pressure. These and other characteristics, such as excellent insulating and thermal properties, led to their application in a wide variety of products ranging from carbonless copying paper to heat exchange and hydraulic fluids, as well their use in electrical transformers and capacitors.

PCBs were never manufactured in Canada and their manufacture in the United States was terminated voluntarily in 1977. They were imported into Canada, mainly from the United States, in the pure form or as askarel. Askarel, as defined by the American Society for Testing and Materials, is a generic descriptive name for any synthetic electrical insulating (dielectric) material which, when decomposed by an electric arc, evolves only nonexplosive gases or gaseous mixtures.

In this handbook, askarel is synonymous with a mixture of PCBs and chlorinated benzenes (primarily tri- and tetrachlorobenzene). The composition of the different brands of askarel varies significantly depending on the application and the manufacturer. Most transformer askarels contain PCBs in a concentration from 40 percent to 70 percent. The two askarel formulations most commonly used in Canada were Pyranol and Inerteen, used in electrical equipment manufactured by Canadian General Electric and Westinghouse, respectively. They contain approximately 60 percent and 70 percent PCBs, respectively. Table 1 lists the best known brands of askarel and their countries of origin. Most capacitors that use PCBs contain them in the undiluted form.

TABLE 1 BRAND NAMES AND ORIGIN OF ASKARELS

Name	Country of Origin	Name	Country of Origin
Apirolio	Italy	Inclor	Italy
Aroclor	United States, United Kingdom, Japan	Inerteen	United States
		Kanechlor	Japan
Asbestol	United States	Montar	United States
Chlophen	Germany	No-Flamol	United States
Chlorextol	United States	Phenoclor	France
Chlorinol	United States	Pydraul HY	United States
Diaclor	United States	Pyralene	France
DK (Decachloro-diphenyl)	Italy	Pyranol	United States
		Pyroclor	United States
Dykanol	United States	Saf-T-Kuhl	United States
Elemex	United States	Santotherm FR	Japan
Eucarel	United States	Sovol	Union of Soviet Socialist Republics
Fenclor	Italy		
Hyvol	United States	Therminol FR HT	United States

1.1 Environmental Contamination by PCBs

PCBs were first discovered in the environment in the late 1960s by researchers who were looking for another chlorinated organic compound, DDT (dichlorodiphenyltrichloroethane). A number of subsequent studies confirmed the widespread existence of PCBs in the environment in low concentrations. These discoveries led the Organization for Economic Cooperation and Development (OECD) to call for member countries to restrict the use of PCBs to closed applications (e.g., transformers).

PCBs can contaminate the environment by several routes. Current levels of PCB contamination are partly due to the improper landfill disposal in the past of products that contained PCBs, such as carbonless copying paper, caulking compounds and even electrical equipment. In addition, PCBs that leaked from damaged or rusted electrical equipment, or spilled or were poured onto the ground, eventually seeped into rivers and lakes. Such releases generally do not occur now, so concern has partially shifted to other potential sources of release such as poorly maintained electrical equipment or the transportation of electrical equipment that contains PCBs. A release during transport is more likely to occur if the equipment is being transported in violation of the provisions of the Federal Transportation of Dangerous Goods Regulations.

Although they have a low vapour pressure, liquid PCBs can become airborne, especially through *improper* incineration, i.e., incineration at temperatures too low to destroy the PCBs. During improper incineration, PCBs are adsorbed onto particulate matter; they can then be dispersed by the wind and deposited in dry fallout or precipitation. Consequently, PCBs and products containing PCBs should only be incinerated in facilities approved for their destruction.

Once present in the environment, PCBs are persistent. Because they can accumulate in body tissues, PCB contamination can be passed up the food chain. A good example of how this can happen is that fish can ingest PCBs in water, sediment or plants and then the contaminated fish can be consumed by animals and humans.

1.2 Health Effects of PCBs

Toxicity is the ability of a substance to cause injury to living tissue once it reaches a susceptible site in or on the body. PCBs are often regarded as highly toxic but their effects are much less categorical than that. First of all, PCBs do not pose a threat to human health unless exposure occurs through inhalation, absorption or ingestion. Secondly, the potential for harm depends on the source of exposure: environmental, accidental or occupational.

Everyone is unavoidably exposed to traces of PCBs which contaminate the environment, but there is no evidence that low levels of PCBs in the environment have actually affected human health. A more serious health concern is the accidental contamination of food with high concentrations of PCBs. In fact, concern about the potential for PCBs to cause adverse health effects in humans first arose in 1968, after an incident of food poisoning, known as Yusho, occurred in Japan. More than 1000 people exhibited symptoms such as nausea and chloracne (a severe skin eruption) after consuming food cooked in rice oil that had been contaminated by PCBs leaking from a heat exchanger in a food processing plant. Although not proven, it is suspected that the toxicity of the PCB-containing fluids may actually have been due to the presence of contaminants such as polychlorinated dibenzofurans (PCDFs).

A third type of PCB exposure is occupational. In the past, when electrical equipment containing PCBs was still being manufactured, workplace exposure was common. Although PCB exposure has been virtually eliminated in today's workplace, fires involving PCB-equipment still present a special case of occupational exposure. When PCBs are heated at temperatures between 250°C and 750°C, they can be converted to

PCDFs. If askarels are heated, the chlorobenzenes in them can be converted to polychlorinated dibenzodioxins (PCDDs). Both PCDFs and PCDDs, commonly known as furans and dioxins, are widely considered to be more toxic than PCBs. An Environment Canada report "Fires in Electrical Equipment containing PCBs" (March 1985) contains additional information on this subject.

Brief exposures to small amounts of PCBs are not a serious health concern. Long-term occupational exposure to PCBs has not been shown to result in any statistical increase in cancer or death. There is no definitive answer to the question: "Are PCBs carcinogenic (cancer-causing) in humans"? The media often describe PCBs as "cancer-causing", but PCBs have only been shown to cause cancer in laboratory animals. The International Agency for Research on Cancer considers PCBs "*probably* carcinogenic in humans" but the scientific community is divided on the issue.

No direct evidence has linked PCBs to birth defects or chromosomal changes in humans. PCBs have been implicated in reproductive effects such as low birth weight, specifically in the Yusho poisoning. In the Yusho case, however, all low birth weight children attained normal weight within one year of birth. In addition to reproductive effects in humans, there is strong evidence that PCBs are responsible for reproductive effects in wildlife, such as reduced litter sizes of otters and minks, and birth defects, such as crossed beaks, in birds. These well-known effects, combined with the widespread environmental distribution and extreme persistence of PCBs, as well as their ability to bioaccumulate, prompted the federal government to regulate PCBs.

1.3 Federal Government Regulations and Guidelines

The importation, manufacture, sale and use of PCBs, and products, machinery and equipment containing them, are controlled federally under the Environmental Contaminants Act. The Act is the joint responsibility of Environment Canada and the Department of Health and Welfare; Environment Canada administers the Act and Health and Welfare determines the potential health effects of environmental contaminants.

Three chlorobiphenyl (PCB) regulations (see Appendix A) have been introduced under the Environmental Contaminants Act. In these regulations, PCBs are defined as chlorobiphenyls that have the molecular formula $C_{12}H_{(10-n)}Cl_n$ in which "n" is greater than 2; the chlorobiphenyls for which "n" is 1 or 2 (i.e., mono- and dichlorobiphenyls) are considered less toxic than the more highly chlorinated biphenyls and are consequently not regulated.

The Chlorobiphenyl Regulations No. 1, as amended, prohibit many commercial, manufacturing and processing uses of PCBs. They prohibit the use of PCBs in the operation of, and as a constituent of any product, machinery or equipment except for specifically exempted equipment such as electrical transformers and capacitors manufactured in or imported into Canada before July 1, 1980. The regulations specify that PCBs may only be used in the servicing and maintenance of electromagnets and electrical transformers and their associated equipment. They also prohibit the use of PCBs as a new filling or make-up fluid in the servicing or maintenance of electrical transformers and electromagnets.

The Chlorobiphenyl Regulations No. 2 (Product) specify that the maximum allowable concentration of PCBs in specified products, such as electrical transformers and capacitors designed to use PCBs, is 50 ppm. This restriction applies to the importation, manufacturing and offering for sale of these products but does not apply if the specified products are offered for sale as a necessary and integral part of an immovable building, plant or structure that is offered for sale, or are imported or offered for sale for the destruction of the PCBs contained therein.

The Chlorobiphenyl Regulations No. 3 (Release) specify that the maximum concentration of PCBs that can be released in the course of a commercial, manufacturing or processing activity is 50 ppm, except for road oiling, where the limit is 5 ppm. The maximum quantity that can be released during the course of the operation, servicing, maintenance, decommissioning, transportation or storage of specified equipment, such as electrical transformers manufactured before July 1, 1980, is 1 gram per day.

Federal regulations applying to the transport of PCBs have been developed under the Transportation of Dangerous Goods Act. Federal guidelines pertaining to the management of PCB wastes are included in Environment Canada's "Manual for the Management of Wastes Containing Polychlorinated Biphenyls (PCBs)" (1987), which also provides recommendations for the disposal of materials, such as mineral oil, contaminated with PCBs.

1.4 Other Regulations

Provincial legislation for the control of PCBs has also been introduced. The appropriate provincial environment ministries should be contacted for more details (see Appendix B).

IDENTIFICATION AND LABELLING OF PCB EQUIPMENT

2.1 Introduction

In this handbook, PCB equipment means electrical equipment that was designed to use PCBs. PCB equipment includes PCB transformers and PCB capacitors.

2.2 Identification of PCB Transformers

Transformers are manufactured in a variety of shapes and sizes and are either dry-type or liquid-filled. An example of a liquid-filled transformer is shown in Figure 1. In transformers containing dielectric fluid, the fluid also serves as a heat exchanger; heat from the windings is transferred to the casing. If the heat transfer capacity of a transformer casing is not sufficient, cooling tubes or fins can be added. These operate like a car radiator. Most larger transformers are characterized by these tubes or fins.

Transformers can be found in a number of locations (Figure 2), i.e.:

a. Indoors
   i) mounted on a wall or column,
   ii) in an electrical room or fenced enclosure,
   iii) within fire-proof vaults, and
   iv) in mines and underground vaults.

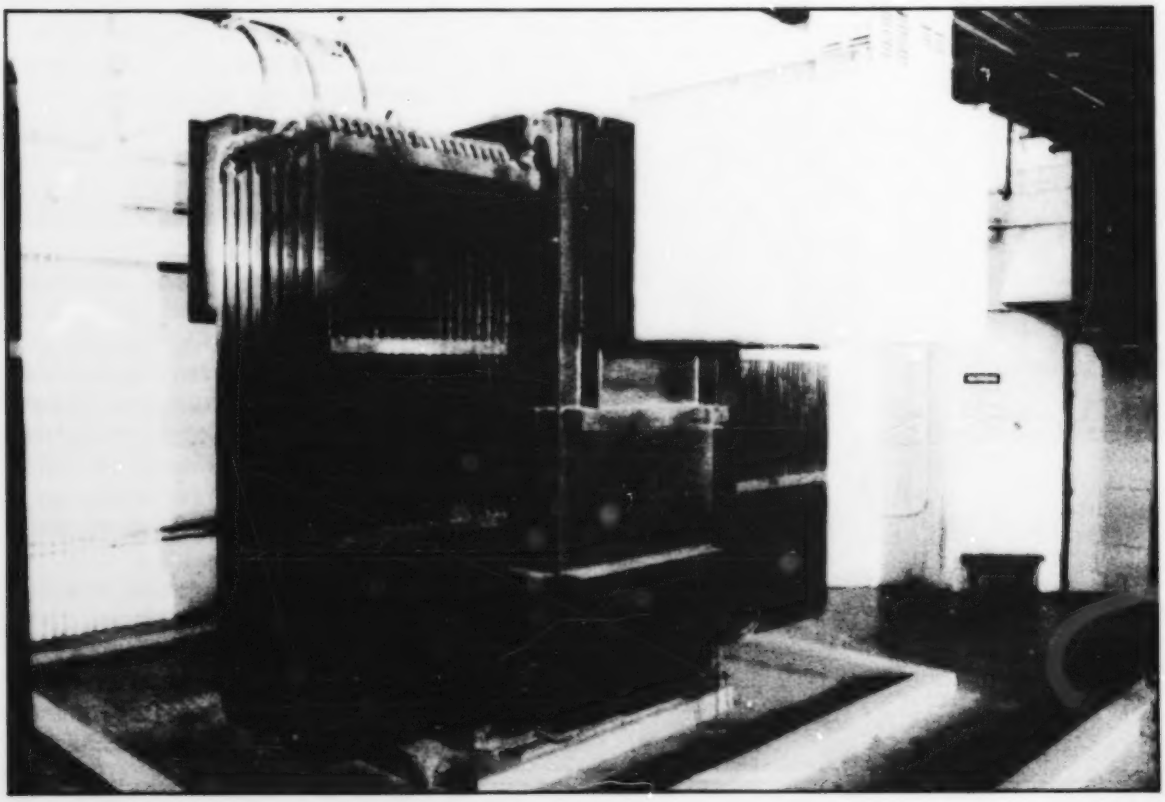
b. Outdoors
   i) on a roof,
   ii) on a concrete pad, and
   iii) on a utility pole.

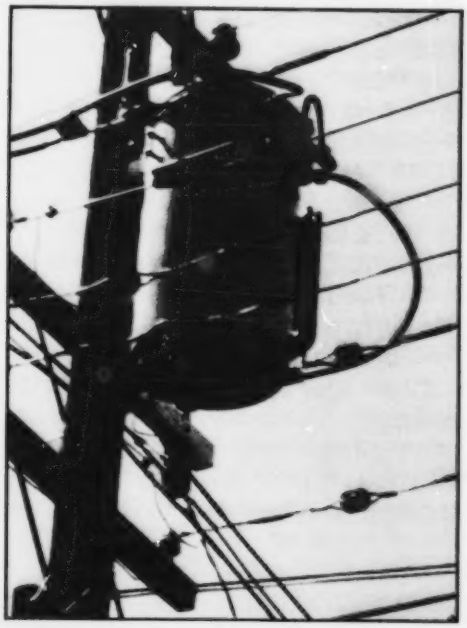
Indoor liquid-filled transformers must be nonflammable unless they are installed in a fire-proof vault approved by the electrical inspection authorities. PCBs have very low flammability and were considered ideal for use in indoor

FIGURE 1

LIQUID-FILLED TRANSFORMER

Pad-mounted
may contain askarel





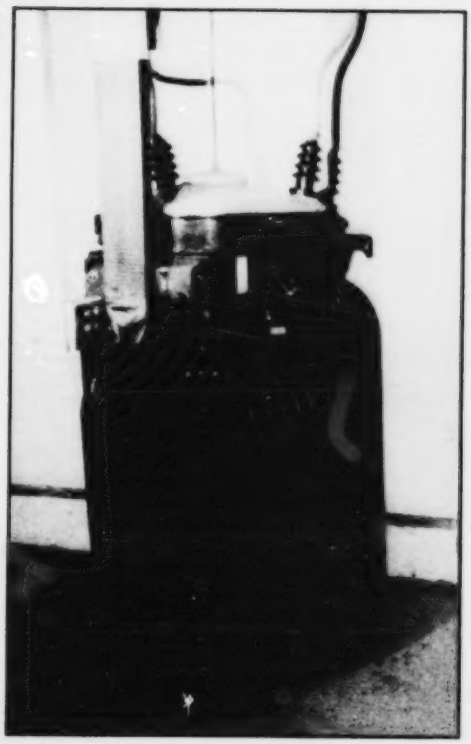


FIGURE 2
TYPICAL TRANSFORMER LOCATIONS

liquid-filled transformers. Consequently, transformers of the type installed indoors prior to 1979, in locations other than fireproof vaults, often contain PCBs.

Not all transformers contain PCBs; the following procedures can be used to determine which transformers contain PCBs and which ones do not. First, a liquid-filled transformer may or may not have a conservator tank (see Figure 3). Any transformer that was manufactured in North America *with* a conservator tank was *not* designed to use PCBs and probably contains mineral oil. Second, a transformer's nameplate, attached to the outside of the transformer casing, should be checked for information about the fluid content. If the type designation on the nameplate starts with the letter O, such as ONS, ONAN, ONWF, etc., the transformer is filled with mineral oil. If the type designation on the nameplate starts with the letter L, such as LNAN, LNAF, LNWF, etc., the transformer is filled with nonflammable or flame-retardant liquid. Most of the "L" transformers manufactured before 1979 are PCB transformers. Some of the "L" transformers manufactured before 1979 and all "L" transformers manufactured in or after 1979 were originally filled with flame-retardant liquid such as silicone or other alternative non-PCB fluids described in Chapter 4 of this handbook. Some nameplates specify the brand of cooling liquid inside the transformer. If one of the brand names listed in Table 1 appears on the nameplate, the transformer contains PCBs. Sometimes the nameplate does not provide information on the fluid content, in which case the manufacturer or Environment Canada can be contacted for additional information.

Askarel can be distinguished from other fluids, such as mineral oil, by physical characteristics. The most obvious difference is the strong odour of askarels, due primarily to the tri- and tetrachlorobenzenes (TTCBs) contained in them. Physical characteristics useful in the

identification of askarels are listed in Table 2; however, a proper laboratory test is the best way to obtain positive confirmation.

Used askarel does not usually have the same appearance as new askarel. It can become contaminated with dirt, moisture, black carbon particles (from arcing) and pieces of insulation from inside the equipment. Contamination degrades the performance of askarel and clouds or darkens its appearance.

2.3 PCB-contaminated Mineral Oil Transformers

Mineral oil-filled transformers were not designed to use PCBs but many of them have been found to be contaminated with PCBs in concentrations exceeding 50 ppm. Several possible explanations have been advanced to account for this finding:

i) transformer plants producing both PCB and non-PCB transformers may have used common filling equipment for both;
ii) askarel may have been used as a make-up fluid for mineral oil-filled equipment; or
iii) equipment may have been used for servicing both askarel and mineral oil transformers without proper cleaning.

PCB-contaminated mineral oil transformers are not the focus of this handbook. However, they are subject to regulations which also apply to PCB transformers. The Chlorobiphenyl Regulations No. 3 (Release) prohibit the release of PCBs in quantities exceeding 1g per day from any transformer manufactured in or imported into Canada prior to July 1, 1980, and in concentrations above 50 ppm for transformers manufactured or imported after that date. Provincial regulations and control criteria might also apply to out-of-service or stored PCB-contaminated mineral oil transformers.

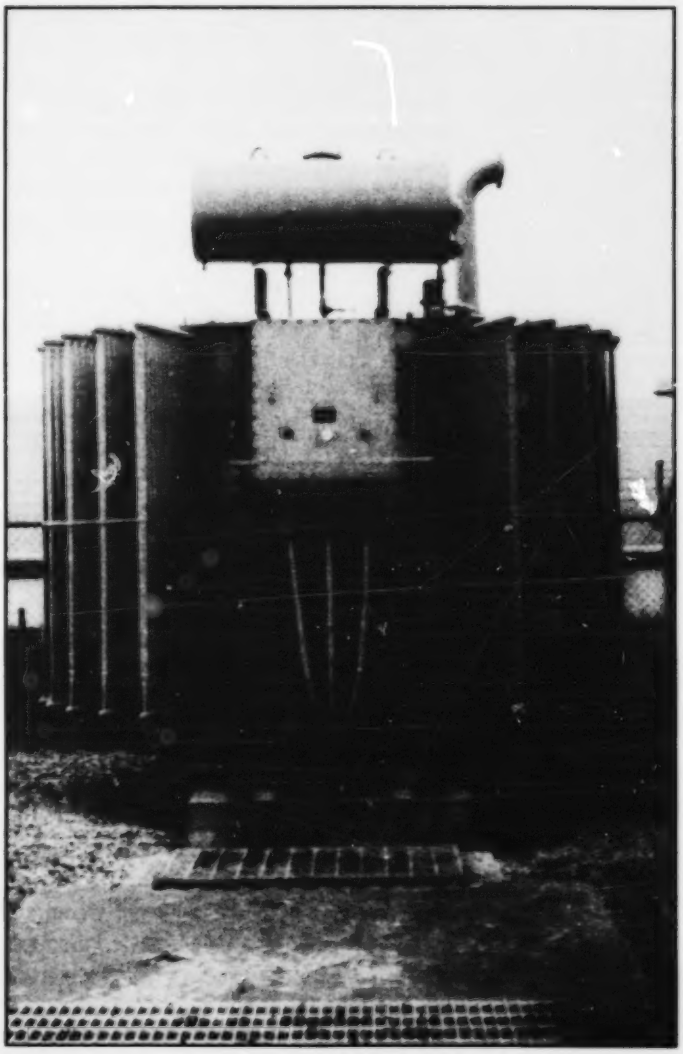


FIGURE 3

LIQUID-FILLED TRANSFORMER WITH CONSERVATOR TANK

TABLE 2 PHYSICAL CHARACTERISTICS OF ASKAREL

Colour	crystal clear to pale yellow
Density	denser than water
Odour	bitter smell
Texture	somewhat slippery
Vapours	invisible

If there is uncertainty about the PCB concentration of a mineral oil-filled transformer, a sample should be taken for analysis (it may be necessary to acquire professional services for the removal of transformer fluid samples). Field test kits can be used to determine whether or not a sample of mineral oil contains PCBs in a concentration greater than a specified amount, such as 50 ppm. Many of these kits are easy to use and give quick results, employing a simple colour transformation that indicates whether PCBs are present in a concentration greater or less than the specified amount. These kits should only be employed as a preliminary screening tool. Samples that test positive with a kit should be sent to a laboratory for confirmatory analysis using gas chromatography.

Treatment technologies have been developed to reduce or eliminate PCB contamination in dielectric fluids such as mineral oil. Several processes for the treatment of contaminated mineral oil have been introduced commercially. These processes are mobile and are designed for either on-line continuous or batch treatment. Additional information can be found in the "Manual for the Management of Wastes Containing Polychlorinated Biphenyls" (Environment Canada, 1987).

2.4 Identification of PCB Capacitors

Capacitors have a number of uses, including:

i) power factor correction, to achieve more efficient operation of AC induction motors, furnaces and other inductive loads;
ii) starting aid for single phase motors;
iii) surge protection for both electronic and power equipment, such as large motors;
iv) voltage regulation for power lines; and,
v) lamp ballasts for fluorescent and high intensity discharge light sources.

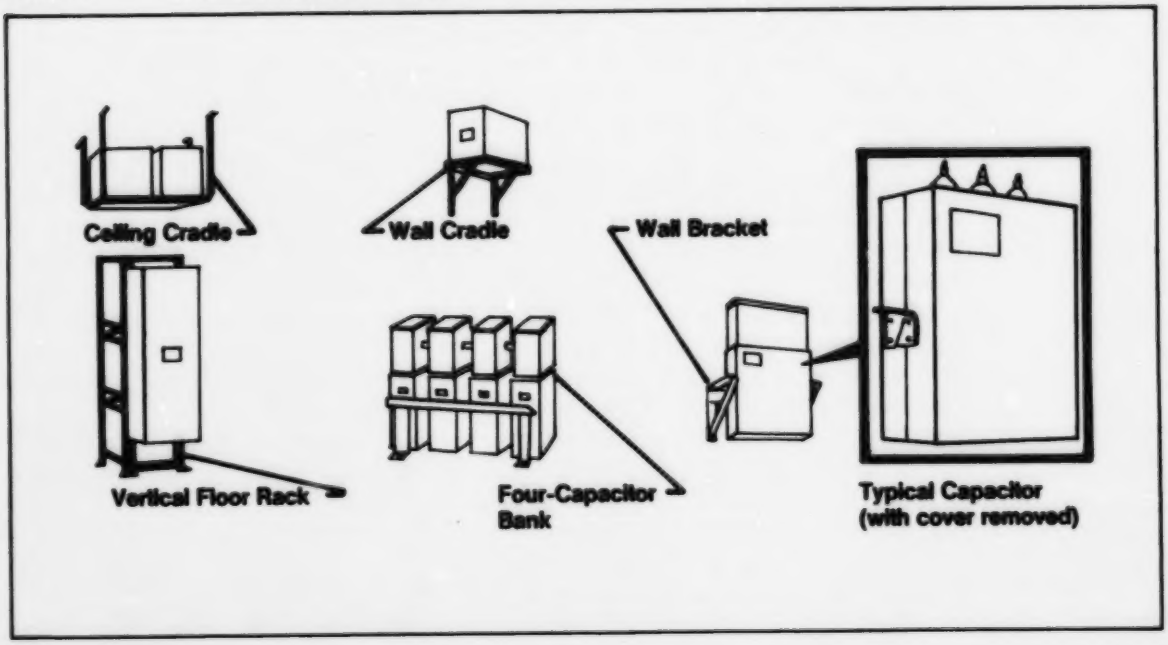
Capacitors vary in size considerably, from the size of an ice cube to much larger than a refrigerator. They can often be recognized by the letters kVar stamped on their nameplates. These letters indicate the electrical rating of a capacitor which most often falls within the 5 kVar to 200 kVar range.

Capacitors can be found in both indoor (Figure 4) and outdoor locations, usually installed in cool, dry areas to allow for efficient operation. Capacitors located outdoors are usually enclosed in a weatherproof welded, steel housing of rectangular construction. Capacitors may be found in a variety of locations within a building:

i) in the plant area, wired to bus bars feeding a row of motors or electric welders;
ii) wired to the electrical terminals of AC motors (if 30 horsepower or larger), electric welders and induction furnaces;
iii) connected to motor control centre panels; and
iv) connected to the main service cables inside the electrical room.

Practically all liquid-dielectric AC power capacitors manufactured between 1930 and 1977 contain PCBs. In general, capacitors contain much smaller amounts of PCBs per unit than transformers. A PCB capacitor measuring 10 cm × 10 cm × 25 cm would contain approximately 1 kg of PCBs and even the largest (200 kVar) power factor correction capacitor contains only about 80 kg of PCBs. Most of the PCBs are absorbed in the paper or other solid dielectric material. Non-PCB capacitors manufactured after 1978 are often marked: "No PCBs" or "Non-PCB Capacitor". Capacitors containing the dielectric fluids WEMCOL, FARADOL 100, DIELEKTRO II or DPO (as specified on nameplates) do not contain PCBs. All other AC power capacitors must be assumed to contain PCBs. Capacitors, unlike transformers, are usually hermetically sealed and analysis of the fluid for PCB content is not practical.

FIGURE 4 TYPICAL INDOOR CAPACITORS



PCB capacitors found in lamp ballasts constitute a special case because of their small size and relative inaccessability. These capacitors are usually encapsulated in an asphalt-type compound in a steel enclosure installed inside the lighting fixture. Ballasts for high intensity discharge lamps are often mounted remotely from light fixtures. A typical capacitor utilized in a fluorescent lamp ballast contains only about 25 g of PCBs. PCB capacitors in high intensity discharge lamps contain significantly more, usually about 300 g. Since 1978, fluorescent lamp ballasts have been manufactured without PCB capacitors. Environment Canada's "Identification of Fluorescent Lamp Ballasts Containing PCBs" (1986) provides useful information for evaluating ballasts.

2.5 Labelling of PCB Equipment

Environment Canada has developed a labelling system for PCB equipment in order to:

i) provide immediate identification of PCB equipment; and

ii) facilitate the development of a national inventory of PCB equipment, i.e., PCB capacitors and askarel transformers.

The inventory assists in keeping track of the current locations of PCB equipment and could be useful in developing a PCB phaseout strategy in the future. Whenever PCB equipment is removed from service and placed in storage or otherwise disposed of, the nearest office of Environment Canada should be notified (see Appendix B).

All equipment that contains PCBs in concentrations greater than 50 ppm should be labelled as a precautionary measure for users of the equipment and as a reminder that it must be treated as PCB-contaminated waste when taken out of service. Although the labelling of in-service PCB equipment is voluntary, industry has largely co-operated with this program.

Two labels (Figure 5) are available for in-service equipment designed to use PCBs. These labels are serialized and have individual registration numbers at the bottom. The label shown in Figure 5a measures 15 cm × 15 cm and should be used on askarel transformers. The label shown in Figure 5b measures 7.6 cm × 7.6 cm and should be used for labelling capacitors. Where a number of capacitors are found together, such as in a capacitor bank, one label may be used for the entire group regardless of the size of the individual capacitors; however, when a capacitor is removed from the bank for disposal it should be labelled. Equipment that contains PCB capacitors, e.g., radio transmitters and fluorescent lamp ballasts, does not have to be labelled. Labelling is advised, however, if the capacitors in such equipment are accessible and large enough to be labelled.

A non-serialized version of the 15 cm × 15 cm label is available (Figure 6) and should be used as a general warning label and placed in a clearly visible position at entrances to locations where PCB equipment is found. Such locations, most often containing drums of waste, include fenced storage compounds, electrical rooms and transformer vaults.

A warning label has been developed specifically for PCB-contaminated equipment (Figure 7). When a piece of equipment is suspected of being contaminated with PCBs, and if an activity is to be carried out to which the regulations apply, then it would be highly advisable to analyse the fluid for PCB content. If PCBs are found, a warning label should be placed on the equipment. This label provides space for entry of: PCB concentration, date of analysis, company name and the signature of an authorized company official.

All of the labels discussed above are available from the regional offices of Environment Canada (see Appendix B).

FIGURE 5 SERIALIZED LABELS FOR PCB EQUIPMENT

ATTENTION
CONTAINS PCB CONTIENT DES
POLYCHLORINATED BIPHENYLS BIPHÉNYLES POLYCHLORÉS
A TOXIC ENVIRONMENTAL CONTAMINANT SCHEDULED UNDER THE ENVIRONMENTAL CONTAMINANTS ACT. IN CASE OF ACCIDENT, SPILL OR FOR DISPOSAL INFORMATION, CONTACT THE NEAREST OFFICE OF THE ENVIRONMENTAL PROTECTION SERVICE, ENVIRONMENT CANADA.
PRODUITS TOXIQUES MENTIONNÉS DANS L'ANNEXE DE LA LOI SUR LES CONTAMINANTS DE L'ENVIRONNEMENT. EN CAS D'ACCIDENT, OU DE DÉVERSEMENT, OU POUR SAVOIR COMMENT LES ÉLIMINER, CONTACTER LE BUREAU DU SERVICE DE LA PROTECTION DE L'ENVIRONNEMENT, MINISTÈRE DE L'ENVIRONNEMENT LE PLUS PRÈS.
OR 26900

a) Label for Large Equipment (e.g., Transformers)

b) Label for Small Equipment (e.g., Capacitors)

ATTENTION
CONTAINS PCB CONTIENT DES
POLYCHLORINATED BIPHENYLS BIPHÉNYLES POLYCHLORÉS
A TOXIC ENVIRONMENTAL CONTAMINANT SCHEDULED UNDER THE ENVIRON MENTAL CONTAMINANTS ACT IN CASE OF ACCIDENT SPILL OR FOR DISPOSAL INFORMATION, CONTACT THE NEAREST OFFICE OF THE ENVIRONMENTAL PROTECTION SERVICE. ENVIRONMENT CANADA
PRODUITS TOXIQUES MENTION-NÉS DANS L'ANNEXE DE LA LOI SUR LES CONTAMINANTS DE L'ENVIRONNEMENT EN CAS D'ACCIDENT, OU DE DÉVERSEMENT, OU POUR SAVOIR COMMENT LES ÉLIMINER, CONTACTER LE BUREAU DU SERVICE DE LA PROTECTION DE L'ENVIRONNEMENT, MINISTÈRE DE L'ENVIRONNEMENT LE PLUS PRÈS

FIGURE 6

UNSERIALIZED PCB WARNING LABEL

ATTENTION
CONTAMINATED WITH PCBs (POLYCHLORINATED BIPHENYLS)
CONTAMINÉ PAR BPCs (BIPHÉNYLES POLYCHLORÉS)
THE CONTENTS OF THIS EQUIPMENT ARE CONTAMIN-ATED WITH PCBs, AN ENVI-RONMENTAL CONTAMINANT SCHEDULED AND REGULATED UNDER THE ENVIRONMENTAL CONTAMINANTS ACT. IN CASE OF ACCIDENT, SPILL OR FOR DISPOSAL INFORMATION, CON-TACT THE NEAREST OFFICE OF THE ENVIRONMENTAL PROTECTION SERVICE, ENVIRONMENT CANADA.
LE CONTENU DE CET APPAREIL EST CONTAMINÉ PAR DES BPCs, UN CONTAMINANT ENVIRONNEMENTAL ANNEXÉ ET RÉGLEMENTÉ EN VERTU DE LA LOI SUR LES CONTAMINANTS DE L'ENVIRONNEMENT. EN CAS D'ACCIDENT, OU DE DÉVERSEMENT, OU POUR SAVOIR COMMENT LES ÉLIMINER, CONTACTER LE BUREAU LE PLUS PROCHE DU SERVICE DE LA PROTECTION DE L'ENVIRONNEMENT, MINISTÈRE DE L'ENVIRONNEMENT.
PCB CONCENTRATION (parts per million)
CONCENTRATION DE BPC (parties par million)
DATE ANALYZED
DATE D'ANALYSE
COMPANY NAME
NOM DE LA COMPAGNIE
AUTHORIZED COMPANY OFFICIAL
AGENT OFFICIEL AUTORISÉ

FIGURE 7

WARNING LABEL FOR PCB-CONTAMINATED EQUIPMENT

PREVENTIVE MAINTENANCE FOR PCB EQUIPMENT

3.1 Transformers

Although the normal life expectancy of an askarel transformer is approximately 40 years or longer, conditions such as overloading, high operating temperature and physical abuse can reduce its lifetime and lead to potential operational and environmental hazards. Preventive maintenance to preclude these hazards is tremendously important.

The primary purpose of a transformer is to convert electrical potential from one voltage to another. During this conversion, a great deal of heat is generated and it must be dissipated. Immersion of the core and coil assembly of the transformer in a liquid provides effective cooling. The liquid used for this purpose must not only be a good coolant but also a good electrical insulator (dielectric) such as mineral oil or askarel.

Sparks inside a transformer occur as a result of lightning, switching surges and transient fault conditions on the power line. They normally last only a fraction of a second and the current flow is so small that the disturbance often goes undetected by the protective relays on the power system. These transient phenomena and their harmful effects can be eliminated or greatly reduced by properly sized lightning arresters located close to the primary terminals of the transformer.

FIGURE 8 A TYPICAL PCB TRANSFORMER

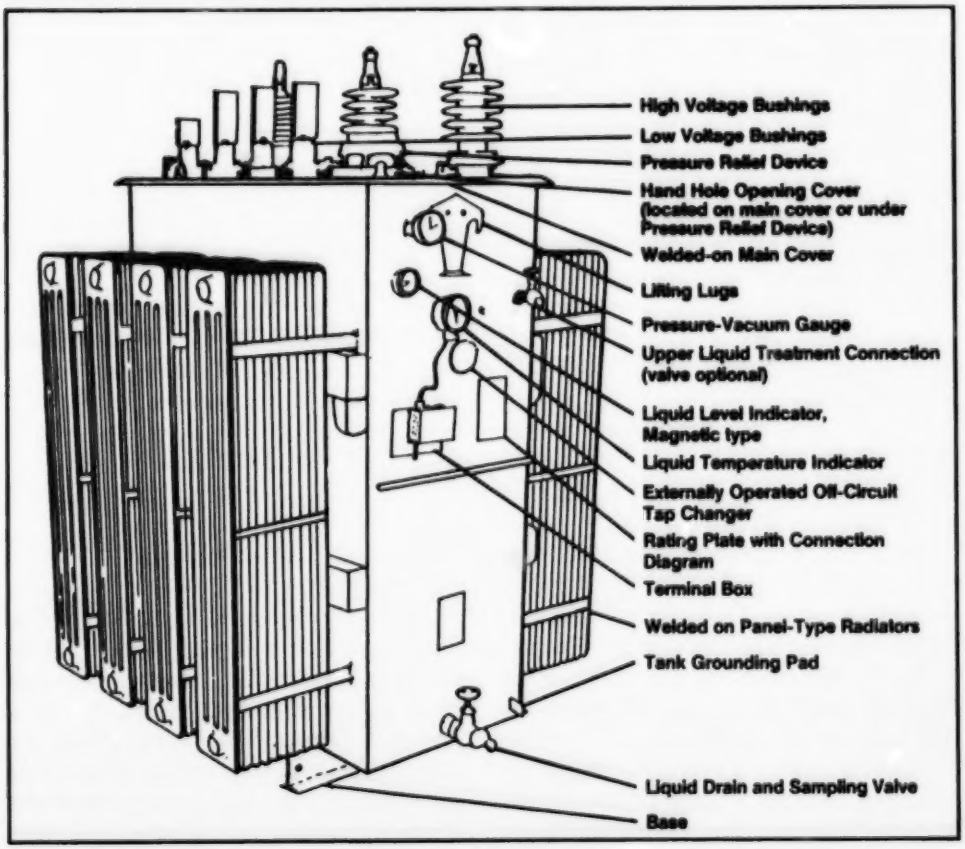
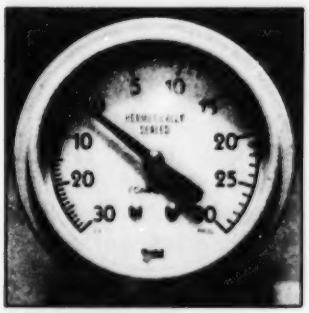

High Voltage Bushings
Low Voltage Bushings
Pressure Relief Device
Hand Hole Opening Cover (located on main cover or under Pressure Relief Device)
Welded-on Main Cover
Lifting Lugs
Pressure-Vacuum Gauge
Upper Liquid Treatment Connection (valve optional)
Liquid Level Indicator, Magnetic type
Liquid Temperature Indicator
Externally Operated Off-Circuit Tap Changer
Rating Plate with Connection Diagram
Terminal Box
Welded on Panel-Type Radiators
Tank Grounding Pad
Liquid Drain and Sampling Valve
Base

FIGURE 9 TRANSFORMER GAUGES

a) Temperature Gauge

b) Liquid Level Gauge



c) Pressure-Vacuum Gauge

High voltage sparks between conductors produce heat and decompose the askarel in the vicinity of the spark. As a result of askarel decomposition, hydrogen chloride (HCl) gas, carbon dioxide (CO_2), askarel vapour, and hydrocarbon gases, as well as carbon particles, are produced. This causes an increase in pressure within the tank but the gases slowly condense and allow the pressure to normalize. Gauges located on the side of a transformer provide the information necessary to detect some of the more significant problems that can arise within a transformer.

The temperature gauge indicates the temperature of the askarel within the transformer (Figure 9a). Normally the operating temperature should be much less than 105°C but small changes can be expected. Excessive temperatures indicate that the transformer is overheating, possibly due to loss of askarel. Action should be taken immediately, as the rate of deterioration of insulating materials in the transformer can double for every 8°C rise above normal operating temperature.

The level of askarel within the transformer tank is indicated by the liquid level gauge (see Figure 9b). Generally, a 5-cm air space between the askarel and the tank lid allows for thermal expansion of the askarel. Gauge readings will vary with temperature and electrical load. The minimum acceptable level should be marked on the gauge. A non-PCB fluid must be used for topping up the tank.

The pressure-vacuum gauge measures the pressure changes in the space between the askarel and the tank lid (Figure 9c). As the askarel expands, the pressure in this space increases. The maximum acceptable reading should be marked on the gauge (usually about 70 kPa (10 psi)); if not, check with the manufacturer. If the askarel expands and the gauge pointer does not move, air could be leaking into the transformer.

Abnormally high pressure indicates that short circuits and arcing may have occurred. Most transformers have a pressure-relief valve which is calibrated to release at abnormally high internal pressure to prevent straining and rupturing of the transformer. The valve is automatic, self-resetting, self-resealing and fitted with a sign to indicate when it is open.

TABLE 3 TYPICAL PROBLEMS WITH TRANSFORMERS

Problem	What Can Happen
Lightning and other power surges.	• High voltage sparks occur inside the transformer, causing a build up of internal pressure. • *Excess* pressure forces askarel out through pressure-relief valve or through weak gaskets. • Possible environmental contamination.
Gradual contamination of the transformer liquid by moisture, dirt, carbon or chemicals as a result of arcing.	• Insulating quality of askarel liquid deteriorates. • Electrical arcs occur inside the transformer since it is no longer properly insulated; arcing leads to a buildup of internal pressure. • *Excess* pressure forces askarel out through pressure-relief value or through weak gaskets. • Possible environmental contamination.
Weakening of transformer seals and gaskets due to aging.	• Leaks develop. • Transformer overheats or burns out due to askarel loss. • Electrical arcs occur inside the transformer since it is no longer properly insulated. • Catastrophic failure might occur.
Physical damage or rusting of the cooling radiators. Structural damage to transformer tank.	• Leaks develop. • Transformer overheats or burns out due to askarel loss. • Electrical arcs occur inside the transformer since it is no longer properly insulated.
Overheating because the transformer is undersized for its application (overloading), or because of loss of askarel.	• Insulation on electrical windings and insulation materials deteriorate, allowing short circuits and internal sparks to occur between windings. • Decrease in life expectancy and possible loss of askarel to the environment.

An abnormally low pressure reading indicates a low askarel level; transformer burnout will occur if the level of the askarel drops below the top part of the transformer windings. Also, air, moisture and dirt can be drawn into the transformer tank through weak gaskets. The minimum acceptable pressure reading should be marked on the gauge; if not, check with the manufacturer.

Most of the problems that can develop with transformers (see Table 3) can be prevented or alleviated through regular maintenance.

A transformer should be located in an area where it is adequately protected from potential

TABLE 4 ALARM INDICATORS

Device	Triggering Event/Mechanism
Temperature Alarm	When temperature rises above a set limit.
Liquid Level Alarm	When askarel drops below set limit.
Pressure-Vacuum Alarm	Contacts remain closed under normal conditions.
Pressure-Relief Valve	Contacts close every time valve operates.
Sudden Pressure Relay	Contacts close whenever there is an abnormally rapid increase in internal pressure which would not cause the pressure-relief contacts to close.
Winding Temperature Indicator	Several sets of contacts close at preset temperature increases.

external damaging conditions such as excessive heat, caustic environments and vehicular traffic. The floor surrounding a transformer should be drain-free to prevent fluid from a leaking unit from entering the environment through the sewer system. The transformer site should be well ventilated, especially if it is a separate vault. The ventilation system should provide for air filtration prior to exhaust in the event that airborne PCB contamination is present (e.g., after a fire). Also, the system should not pass air directly from the transformer vault into the main building ventilation.

To prevent overheating, the manufacturer's recommendations for maximum transformer loading should be strictly observed and monitored. If overloading occurs, prompt action is necessary to reduce the load by the addition of another transformer, or installation of a peak demand controller or power factor correction capacitors.

Indicator devices should be fitted with mechanical contacts that can be connected to alarm systems or circuit controls that automatically de-energize the transformer in case of abnormal events (Table 4).

Transformers must be checked routinely for leaks, overheating and other problems that can arise (Table 5). If a transformer's askarel level falls significantly the unit should be thoroughly checked for leakage. If the askarel level falls below that required for safe operation, an appropriate amount of make-up fluid must be added (see Chapter 4). The importance of routine inspections cannot be overemphasized. They should be carried out at least once every six months. It is especially important to realize that simple inspections should prevent the problems shown in Table 3 from becoming serious, since most involve a gradual rather than a sudden change in operating conditions. Each facility or plant should identify an individual who is assigned the responsibility of transformer inspections and associated record keeping.

3.2 Capacitors

A PCB capacitor has a lifetime of approximately 10 to 20 years. It is hermetically sealed so there is no provision for internal maintenance (Figure 10). Most capacitors are equipped with fusing to "de-energize" it in the event of a breakdown (Figure 11). This prevents the capacitor from bursting open. Typical problems associated with capacitors are shown in Table 6.

TABLE 5 ROUTINE INSPECTION FOR TRANSFORMERS

Inspection	What to look for (and corrective action)
Condition of gauges	• Cracked faceplates, or damaged gauges (install a Plexiglas sheet over gauges for protection).
Reading of gauges	• Change in readings since last inspection. • Readings within the safe or acceptable range (if they are not, consider the addition of make-up fluid).
Corrosion on tank and radiator fins	• Condition of fins. They are manufactured of thin steel to obtain maximum cooling and will rust through more quickly than the rest of the transformer, especially in a caustic environment (clean to bare metal and paint if rusted).
Paint finish of tank and radiator fins	• Weathering paint (repaint as often as necessary).
Leakage of askarel from: – tank – radiator fins – top cover (if gasketed) – manhole cover – top or bottom drain spout – high and low voltage bushings	• Wet slickness and gummy residue. • Deteriorating gaskets or seals. (*Important* — if there has been leakage, take steps to clean it up promptly and repair the fault. The leak should be reported to the appropriate provincial authority. All materials used for cleaning up the PCB leakage must be safely stored as PCB-contaminated waste.)
Pressure-relief valve	• Improperly seated valve due to displaced gaskets.
High and low voltage bushings	• Cracking or chipping. (Replace cracked or chipped bushings.)
Colour of askarel	• Colour changes. • Take a small sample. If the colour is changing from clear to a blue, green, red or black, the askarel is becoming contaminated (consider a laboratory test to check its quality).

FIGURE 10 TYPICAL CAPACITOR

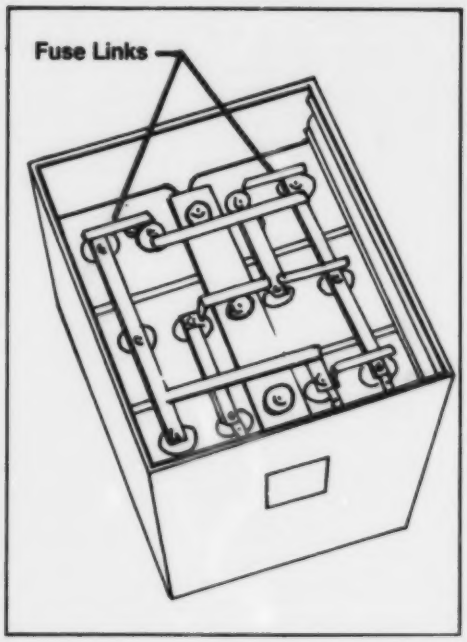


FIGURE 11 CAPACITOR WITH EXTERNAL FUSE

TABLE 6 TYPICAL PROBLEMS WITH CAPACITORS

Problem	What Can Happen
Rusting of casing; damage to insulator bushings	• Leaks develop. • Capacitor overheats and internal insulation fails; with PCB loss, internal short-circuits develop, causing a buildup of pressure inside casing. • Rupture of casing may result in contamination of the environment.
Physical damage to capacitor casing	• Internal insulation may be damaged. • Internal short-circuits can develop, causing a buildup of pressure inside the casing.
Over-heating of capacitor due to loss of askarel or proximity to sources of heat	• Internal insulation deteriorates. • Internal short-circuits can develop causing a buildup of pressure inside casing. • Casing may rupture.
End of lifetime	• Internal insulation fails. • Capacitor draws large amounts of current and pressure is built up inside casing.

Preventive maintenance for capacitors will help lower the risk of environmental contamination; the location of a capacitor is very important in this respect. The casing temperature should not exceed 55°C under normal operating conditions. To avoid risks, take the following precautions:

i) protect from sources of heat;
ii) ventilate adequately (ambient air temperature should be less than 40°C);
iii) protect adequately from damage by outside sources; and
iv) maintain operating voltage within rated limits.

Some capacitors are constructed with a number of individually fused cells. Since a defective capacitor cell can be removed from the circuit when its fuse melts, this design still allows for a certain amount of capacitance.

Routine inspections of capacitors should be carried out, as detailed in Table 7, by a designated staff member at least once every six months.

TABLE 7 ROUTINE CAPACITOR INSPECTION

Inspect	What to look for (and corrective action)
Corrosion on casing	Rusting is more likely to occur in a caustic environment (provide adequate ventilation).
Physical damage	Dents, broken insulator bushings (repair or replace bushings; replace entire capacitor if necessary).
Leakage of askarel	Wet slickness and gummy residue. (*Important* — if there is leakage, store the capacitor in a sealed container until it can be disposed of).
Melted fuses	Some capacitors with external fuses have a visual indicator to signal that the fuse has melted (see Figure 11); alternatively, conduct a continuity test on the capacitor (if the fuse has melted replace it and if it melts again, store the capacitor until it can be disposed (see Chapter 6 for storage instructions).
Temperature of the capacitor casing	Casing should be warm to the touch; if cold, check fuse (if hot, check for cause of the excessive temperature).

SUBSTITUTES FOR PCBs IN TRANSFORMERS

4.1 Substitute Fluids

Sometimes it is necessary to add liquid to a transformer tank to replenish PCBs lost due to leakage or sampling. The Chlorobiphenyl Regulations No. 1 prohibit the use of PCBs as a make-up fluid in the servicing and maintenance of electrical transformers. Fluid losses from an askarel transformer must be made up using non-PCB substitutes that are both compatible with transformer askarels and have no adverse effects on any materials used in the internal construction of the transformers. Excessive amounts of make-up fluid may alter the transformer performance or soften the insulation on the transformer windings. If a large quantity of make-up fluid needs to be added, it must be added slowly to allow mixing with the askarel.

An ideal alternative to PCBs will possess a number of desirable properties, including:

- little degradation while in use over a period of time;
- compatibility with the materials used in the transformer;
- a high fire point for safety;
- a high dielectric strength (>30 kV);
- a high resistance to breakdown from internal arcing;
- a low vapour pressure;
- a low thermal coefficient of expansion;
- a low pour point to enable cold startup;
- a low rate of heat release in the event of a fire;
- good thermal conductivity, specific heat and low viscosity over the entire range of operating temperatures;
- density greater than that of water;
- absence of toxic products in decomposition or combustion;
- non-toxicity and biodegradability in the environment; and
- reasonable cost and adequate supply.

The safest make-up fluid is tri-tetrachlorobenzene (TTCB) which is already a component of all transformer askarels. (Most askarels contain 30 to 40 percent TTCB). Diluting PCBs with TTCB lowers the viscosity of the fluid which improves circulation and the effectiveness of the transformer cooling. However, since the pour point of pure TTCB is much higher than that of PCBs, only a limited quantity of TTCB can be added without creating problems for lightly loaded or de-energized outdoor transformers in cold weather. To provide an adequate margin of safety, it is recommended that no more than one-third of the total original volume of askarel in any outdoor transformer be made up with TTCB. This degree of dilution with TTCB should not present a problem, since transformers should not require more than 30 percent replacement fluid over their operational life.

Table 8 lists substitute fluids for new transformers, along with their advantages and disadvantages. Before adding any make-up fluid, contact the transformer manufacturer for specific advice.

4.2 Retrofilling

Retrofilling involves the removal of all askarel from a transformer, followed by flushing with a solvent and refilling with a non-PCB fluid. Retrofilling is not recommended because there is a lack of PCB disposal facilities and, when facilities are available, storage of the drained askarel and the PCB-contaminated flushing fluids presents, in most cases, a higher risk than the continued use of a properly maintained and safe-guarded askarel transformer. In addition, askarel transformers that have been drained and rinsed several times will still contain residual PCBs in the core which, in time, will diffuse into the transformer fluid. Therefore, retrofilling might not succeed in maintaining the PCB content of the replacement fluid below 50 ppm over the long term.

TABLE 8 SUBSTITUTE FLUIDS

Substitute Fluid	Advantages	Disadvantages
Silicones	• low pour point • high fire point • low rate of heat release upon combustion • fairly low viscosities over the entire range of operating temperatures	• not compatible with some gasket materials, such as silicone rubbers and certain insulation materials • specific gravity of fluid is such that water will sink to bottom of transformer while ice crystals are buoyant and float to top. Melted ice crystals could migrate through fluid and reduce its dielectric strength • cost is relatively high • askarels are soluble in silicones only up to 8%
Aliphatic hydrocarbons (e.g., RTEmp, produced by extensive refinement of crude oil and blending of anti-oxidants, stabilizers and other additives)	• low degree of in-service degradation • compatibility with all materials of construction normally used in electrical equipment • fluid is compatible with all other dielectric fluids • specific gravity is below that of both water and ice • fluid is not a serious environmental hazard (same effects as other mineral oils), is bio-degradable and can be disposed easily • cost is lowest of all askarel substitutes and raw materials are plentiful	• high viscosity at lower temperatures • high rate of heat release during combusion • blended additives (proprietary to the supplier) are required to depress pour point and improve thermal and oxidative stabilities • gassing tendency under electrical stress is equal to or higher than for conventional (naphthenic) transformer oils which are in turn higher than all other askarel substitute fluids

TABLE 8 SUBSTITUTE FLUIDS (Cont'd)

Substitute Fluid	Advantages	Disadvantages
Poly-α-olefins (synthetic hydrocarbons)	• compatibility with all materials used for transformer construction and all other hydrocarbon fluids • lower pour point and slightly better low temperature viscosity than natural aliphatic hydrocarbons • specific gravity below that of water and ice • no gassing under electrical stress	• relatively high rate of heat release during combustion • relatively high cost
Chlorinated benzenes (Tri-tetrachlorobenzenes are components of askarel but can also be used alone)	• physical properties similar to properties of askarel • transformers designed for askarels are generally suitable for TTCBs	• not suitable for use at very low ambient temperatures because of high pour point • exhibit some toxicity and not easily biodegradable
Esters (blend of pentaerithritol and fatty acids)	• high dielectric strength • low flammability • low pour point • no toxic substances generated during arcing conditions • compatible with most materials used in transformers	• no significant disadvantages except higher cost than RTEmp fluid

PCB CONTAINMENT AND CLEAN-UP

5.1 How Releases from PCB Equipment Occur

Askarel can be released from a transformer in a number of ways.

Catastrophic failure occurs only in an energized transformer. It is the rupturing or splitting open of a transformer casing due to a combination of factors: a build-up of internal pressure caused by a power supply problem, failure of the pressure-relief valve to open quickly enough, and a continuing supply of electrical power. Internal pressure results in a rupture at the weakest part of the transformer casing (usually the gaskets or cooling fins). If the opening is above the askarel level, a mixture of hydrogen chloride gas, askarel vapour, and askarel droplets will be discharged. If the opening is below the liquid level, askarel liquid will be released. As the pressure is reduced, the askarel will drain to the level of the opening.

Controlled pressure release is the release of gas and vapour through the pressure-relief valve of an energized transformer. A momentary burst of hydrogen chloride gas, askarel vapour and droplets occurs. Askarel droplets may run down the casing.

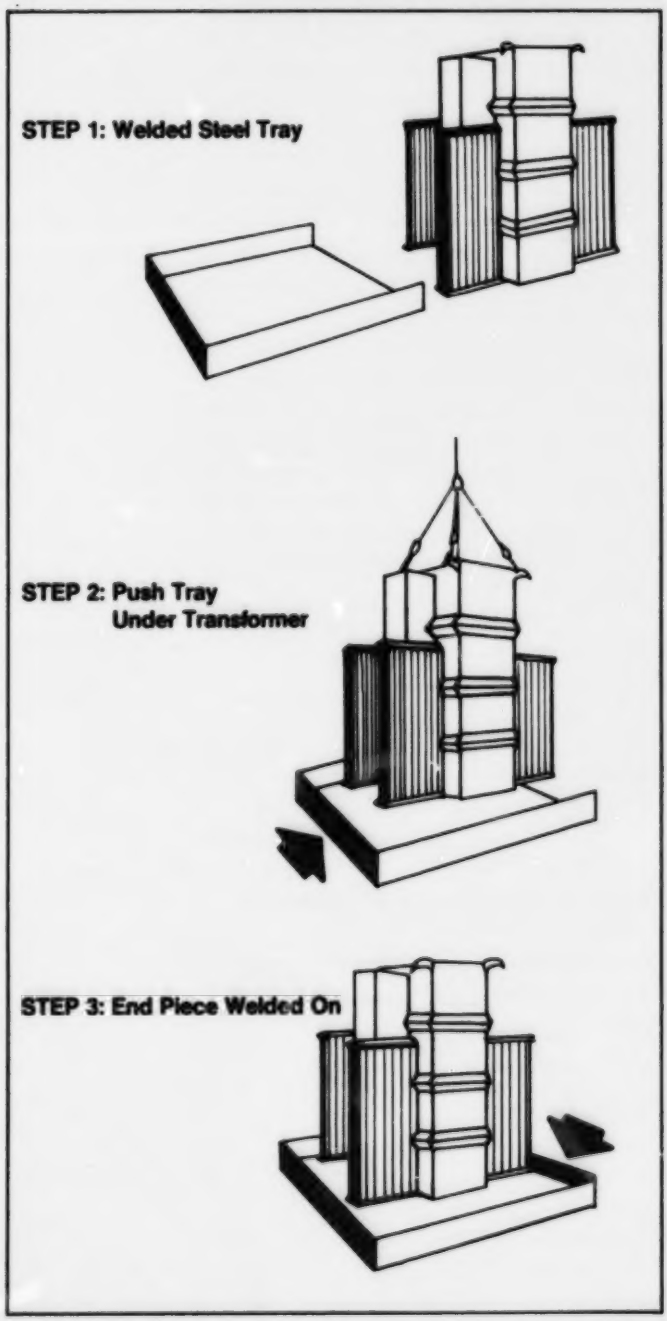
Askarel leakage can occur both in a transformer that is energized and one that is in storage. Leakage may occur through deteriorated gaskets, rust holes in the cooling fins or casing, broken bushings, or punctures in the cooling fins or casing. If the level of the askarel in an energized transformer is below minimum operational requirements, the transformer is no longer properly cooled or insulated, and a controlled pressure release or catastrophic failure can occur.

Energized capacitors may also experience catastrophic failure from a build-up of internal pressure if the power supply is not disconnected in time. The pressure forces an opening through the weakest part of the capacitor. Leakage may occur in an energized or stored capacitor through a physically damaged or rusted casing. Askarel will drain or drip out to the level of the opening.

TABLE 9 COMPATIBILITY OF MATERIALS WITH PCBs

Compatible	Not Compatible
• wood, paper, paperboard	• organic materials other than wood and paper, e.g., varnishes, lacquers, non-PCB resistant paints
• asbestos, glass, ceramic, bakelite, sand	• natural rubber, neoprene rubber, butyl rubber
• aluminum, brass, stainless steel, lead, tin, copper, galvanized iron, black iron	• acrylic resin (polymethylmethacrylate)
• cork, nitrile rubber, cork-nitrile (limited time)	• chlorosulphonated polyethylene
• Viton (DuPont), Teflon, Silastic 50 (Dow Corning)	• PVC (polyvinyl chloride)
• some silicone elastomer materials	• polyvinyl formol
• Glyptal 1276 cement (General Electric)	
• epoxy cement	
• dewaxed orange shellac	
• paints with an epoxy-urethane resin	
• some grouting compounds	
• polyethylene, fluoroelastomer	

FIGURE 12 A SIMPLE CONTAINMENT SYSTEM FOR A TRANSFORMER: METAL DRIP TRAY



5.2 Containment Systems

A containment system will limit the area affected by the accidental release of dielectric fluids from electrical equipment. Containment should be provided wherever PCBs are present, but most especially in food processing plants, grain handling facilities, urban areas, and installations close to waterways and drainage facilities.

A variety of materials may be used to contain spills of PCBs. Materials that are compatible with PCBs (i.e., will not degrade in the presence of PCBs), and those that are not, are listed in Table 9.

The simplest form of containment system is a metal drip tray placed under the transformer or capacitor. The tray must have continuous welding; spot welding is not acceptable. The entire tray should be painted with a PCB-resistant paint to prevent rusting and to facilitate clean-up. The volume of the tray should be at least 125 percent of the volume of liquid in the transformer or capacitor. After the tray is installed, sufficient room should remain for inspections and clean-up operations. The sides of the tray should be low enough to allow for adequate ventilation and to prevent overheating. Because drip trays might not contain all releases in which liquid is sprayed out from the transformer or capacitor, they are best suited for use with decommissioned equipment. Figure 12 shows the construction of a metal drip tray. To prevent damage, a transformer should only be jacked at approved bearing surfaces, or a forklift could be used.

An entire room in which a transformer is housed can be used for containment provided that the floor is concrete, all cracks and drains are sealed and there are curbs surrounding the transformer. Where several transformers are located in one room it is advisable to provide each transformer with a containment system to reduce the area to be cleaned in the event of a spill. The individual containment systems should be constructed of metal or concrete and built to

contain at least 125 percent of the volume of askarel in the transformer.

Figure 13 shows an outdoor containment facility for energized transformers. The following guidelines should be used in constructing an outdoor containment facility for energized transformers:

i) Concrete curbing should be constructed around each transformer.

ii) Concrete surfaces should be thoroughly cleaned (use industrial strength cleaner if necessary) before plugging cracks or applying any sealing paint.

iii) Ensure adhesion between new concrete curbing and an old concrete floor by:
- chipping down the old concrete to a fresh level,
- installing 1.5-cm self-drilling anchor pins on 1-m centres along the perimeter of the new curb, and
- preparing surface with a concrete bonding agent.

iv) All cable-entries to a transformer via the floor should be well-sealed at the floor entrance with an approved PCB-resistant caulking compound.

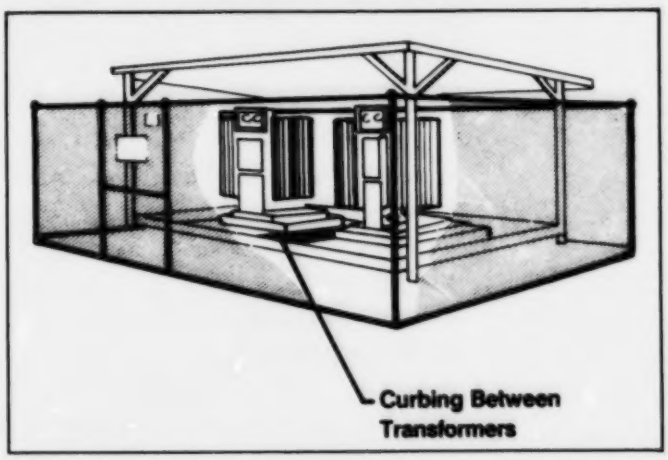
v) Roof-water drainage should be directed away from the inside of the containment facility to prevent a build-up and possible runoff of contaminated water.

vi) Drain spouts should not be incorporated into the base of concrete curbing to drain askarel collected inside the containment area as these spouts can leak and will certainly allow spillage onto the ground during drainage.

5.3 Clean-up Procedures

Clean-up procedures will vary depending on the location and the severity of the spill. Permeable materials (e.g., soils) will require removal. Impermeable surfaces (e.g., sealed concrete and asphalt) can be decontaminated by a triple solvent scrub process followed by sorbent clean-up each time. Unless concrete has been sealed, some of it will probably have to be removed after a spill. Any contaminated structures, buildings or vehicles should be washed with a solvent. Spills into water bodies could pose a difficult clean-up problem and require special consideration. Since PCBs are denser than water, they will settle to the bottom and dredging of contaminated sediment will be necessary in the area of the spill. Spills into pools of water may be cleaned up by bailing or pumping the contaminated water and sediment into secure drums, or by absorbing the contaminated water and disposing of the contaminated saturated absorbent and sediment from the bottom of the pool.

FIGURE 13 OUTDOOR CONTAINMENT FACILITY FOR AN ENERGIZED TRANSFORMER



A list of sorbent materials for spill clean-ups is found in Table 10. Sequential steps for clean-ups are outlined in Table 11. The proper sequence will, of course, depend on the location of the spill.

If possible, equipment and materials for the clean-up of PCB spills should be stored within easy access of the location of the PCB fluids. A PCB spill control "kit" should, at the very least, consist of:

i) sorbents;
ii) hand-operated pump with pump hose;
iii) scoop shovel and bench brush;
iv) cleaning rags;
v) plugs for blocking nearby floor drains;
vi) portable dikes; and
vii) personal safety clothing and equipment, as described in Chapter 6.

All persons authorized to work in the area should be familiar with the location of the "kit" and thoroughly trained in its use. Alternatively, arrangements can be made with a service company specializing in environmental clean-ups.

5.4 Fires Involving PCBs

A fire involving PCBs necessitates special clean-up procedures. Smoke and soot from the fire could be contaminated with chlorinated dioxins and furans, as well as PCBs. Since dioxins and furans are generally regarded as more toxic than PCBs, their presence places an additional emphasis on health and safety concerns. Clean-ups after a PCB fire should be conducted by individuals, agencies or private companies with an established expertise in dealing with such situations. For more information, the Environment Canada publication "Fires in Electrical Equipment Containing PCBs" (1985) should be consulted.

TABLE 10 SORBENT MATERIALS (This list is not exhaustive)

- activated charcoal
- Diasorb (Diamond Shamrock Inc., Cleveland, Ohio)
- Hy-Dry (Tennier Absorbent Products Ltd., Hamilton)
- Imbiber Beads (Dow Chemical Canada Inc., Sarnia)
- Oil-Dry (Waverly Mineral Products Co., Philadelphia)
- peat moss
- Safestep (Andesite of California Inc., Los Angeles)
- sawdust
- soil with a high humus content
- Stay-Dry (Waverly Mineral Products Co., Philadelphia)
- vermiculite

TABLE 11 STEPS FOR CLEAN-UP OF PCBs

Steps Involved	Location of Spill			
	Leakage into Containment System	Spills on Concrete and Asphalt	Spills on Soil	Spills into Water
Notify plant personnel, provincial authorities and Environment Canada of spill and clean-up intentions	1	1	1	1
Take safety precautions and avoid personal contamination	2	2	2	2
Prevent pedestrians and/or vehicles from entering contaminated areas	3	3	3	3
Plug or dike all drains to sewers and ditches		4		
Build dikes to contain PCB fluid in small area			4	
Cover with plastic to minimize runoff from rain		5	5	
Dam area if possible, and close off to vessels in navigable waters				4
Use pump to transfer PCBs into drums and/or soak up PCBs with sorbents	4	6		5
Use dredges to collect contaminated sediment				6
Wipe area with rags and solvents	5	7		
Take core sample to determine penetration		8 (2.5 cm deep)	6 (60 cm deep)	
Remove surface area past level of contamination		9	7	
Dispose of contaminated materials and waste PCBs	6	10	8	7
Monitor wells and other bodies of water in the vicinity for PCB contamination			9	

PREPARATION OF PCB EQUIPMENT FOR STORAGE

6.1 Handling of PCBs

It may be necessary to handle PCBs during the preparation of PCB-equipment for storage and transportation. Stringent precautions must be observed when handling askarel. The following gear should be worn for protection against the hazards of splashes or spills:

i) safety hard hat;
ii) full face shield or chemical-resistant goggles (tight-fitting);
iii) rubberized protective suit that completely covers arms and legs;
iv) rubberized gloves (gauntlet type to provide forearm protection); and
v) rubberized boots.

All rubberized clothing should be made of PCB-resistant material, such as nitrile rubber or, if cost permits, Tyvek, Saranex, or Viton. All protective equipment and clothing that becomes contaminated with askarel should be thoroughly cleaned; if possible, or properly disposed of since some materials deteriorate after exposure and lose their protective efficiency.

Additional ventilation is required when working with askarel at temperatures above 55°C. Fumes at these temperatures can be irritating to the lungs and eyes. The recommended handling temperatures for some commonly used askarels are listed in Table 12. If exposure to hot askarel with a temperature above 55°C is necessary, a self-contained breathing apparatus, or a chemical cartridge-type respirator should be worn. It should be noted that the occupational health hazards

TABLE 12 RECOMMENDED HANDLING TEMPERATURES FOR SOME ASKARELS

Askarel Product	Handling Temperatures (°C)
Pyranol A13B3B-3	20 - 55
Inerteen 70-30	20 - 55
Inerteen 100-42	35 - 75

TABLE 13 FIRST-AID FOR CONTACT WITH ASKAREL

In Case of	First Action	Second Action
Askarel on skin	Wash with soap and water for at least 15 minutes.	See physician if rash develops.
Askarel in eyes	Flush eyes with gentle stream of lukewarm water for 15 minutes keeping eyelids apart.	See physician as soon as possible.
Askarel swallowed	Rinse mouth out with water. Do not give victim anything to drink.	Write down details about the liquid swallowed and take victim to hospital or physican immediately.
Strong askarel fumes	Get victim into fresh air.	If discomfort does not clear up, take victim to physician.

associated with hot askarel are due more to the TTCB in the askarel than the PCBs. Refer to Table 13 for first aid treatment.

Other precautions are necessary when handling askarel. One should:

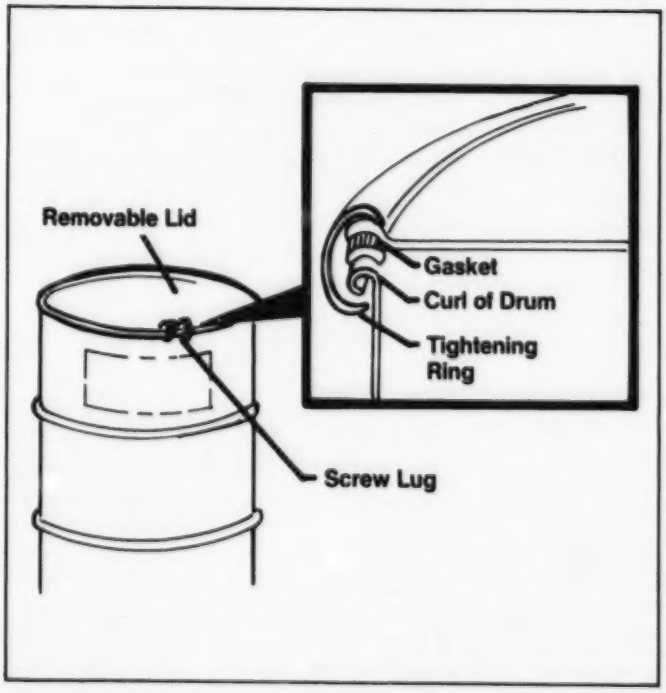
i) pump, not pour, askarel into containers (this minimizes splashing and spillage);
ii) frequently inspect equipment used to handle askarel and replace if necessary;
iii) use askarel pumps and hoses only for this purpose (to prevent cross-contamination);
iv) use centrifugal pumps recommended for handling hot oil, not gear-type or other positive displacement pumps;
v) provide forced air ventilation in the working area and exhaust air to the outside when handling hot askarel.

All wetted surfaces of the pump should be made of stainless steel. The shaft seal should be an external carbon ring type to eliminate exposure of the packing material to the deteriorating effects of askarel. Valves should be brass or stainless steel lined. Hoses should be flexible metal or lined with tetrafluoroethylene (Teflon) or silicone polymers to provide protection against deterioration.

6.2 Collection and Containment of PCBs

Care must be taken during the collection of askarel to prevent any spillage on the ground or down drains. Good quality, 200-litre steel drums (preferably No. 16 gauge or thicker) with a double bung design are the preferred containers. A 7-cm to 10-cm airspace should be left at the top of the drum to allow for liquid expansion. The drums should be clearly marked with the unserialized PCB warning label described in Chapter 2. Askarel that has collected in drip pans under transformers should be transferred to storage drums as soon as possible. Askarel should be moved from one location to another *ONLY* in sealed metal containers which should not be used for any other liquid. Other liquids should not be mixed with the askarel. If a spill occurs, the askarel should be cleaned up immediately, following the instructions provided in Chapter 5. If askarel is moved off the owner's property, the requirements of the Transportation of Dangerous Goods Regulations apply.

FIGURE 14 DRUM FOR CONTAINING PCB CAPACITORS



6.3 Handling PCB Capacitors

PCB capacitors should be left intact, wrapped in a heavy-duty plastic bag and placed into a 200-litre steel drum (no. 18 gauge or thicker) fitted with a removable steel lid and a gasket made of PCB-resistant material such as nitrile rubber, cork or Teflon (Figure 14). The capacitors should be stored with the terminals up to prevent leakage from the capacitor bushings. The drum should be packed with sawdust or some other sorbent so that any leaks will be absorbed. The drum should then be sealed, labelled with an unserialized PCB warning label and moved to a storage area. Capacitors that do not fit into drums should be placed in heavy gauge plastic bags which are then heat sealed. The packaged capacitors should then be crated for shipment to an approved storage area.

6.4 Handling PCB Transformers

The Chlorobiphenyl Regulations No. 2 (Product) prohibit the sale or resale of transformers and capacitors designed to use PCBs unless the PCB content is less than 50 ppm. In addition, the Transportation of Dangerous Goods Regulations place restrictions on the movement of transformers containing PCBs. In decommissioning (i.e., taking out of service) a PCB transformer, owners and plant personnel must be fully cognizant of their responsibilities for ensuring proper storage of the unit (usually on-site) until approved destruction facilities are available.

If a decommissioned transformer is to be returned to service at some future date, a containment system similar to that described in Chapter 5 should be constructed and arrangements made for periodic inspections. On the other hand, if a PCB transformer is being retired, it should be stored following the procedures outlined in Chapter 7. The unit should not be drained and rinsed except to comply with the Transportation of Dangerous Goods Regulations when there is a requirement to transport the carcass. Draining and rinsing generate additional PCB waste and rinse materials which must be stored and eventually destroyed. In addition, rinse materials, such as kerosene, are highly combustible and, when co-stored with askarels, increase the possibility of fire in the storage area.

PCB transformers cannot be sold for scrap unless *all* of the PCBs contained within them are removed *or* the PCB concentration of the remaining fluid is reduced below 50 ppm. As both of these operations are extremely difficult, selling drained PCB transformers for scrap is not a viable option.

6.5 Waste Disposal

This handbook does not address waste disposal. If information on this subject is required, consult the Environment Canada publication "Manual for the Management of Wastes Containing PCBs" (1987). In addition, as waste disposal is primarily a provincial responsibility, the appropriate provincial agency should be contacted to determine provincial regulatory requirements. Appendix B contains a list of provincial contacts.

ON-SITE STORAGE OF PCB EQUIPMENT AND CONTAMINATED MATERIALS

7.1 Introduction

This chapter deals with facilities for on-site storage of PCB equipment and contaminated materials. Some typical classifications are listed in Table 14. Bulk storage facilities for PCBs, such as may be required at a central multi-user storage, transfer or disposal facility, are not discussed. Consequently, if owners of PCB equipment wish to move it to a centralized storage facility, they should contact the Department of Transport to determine the exact requirements of the Transportation of Dangerous Goods Regulations; a list of contacts can be found in the "Manual for the Management of Wastes containing PCBs".

7.2 Location and Design of Storage Facilities

Storage facilities can be installed indoors or outdoors. An indoor storage area is preferable because the risk of contaminating stormwater runoff is eliminated. To reduce the risk of accidental release in transit, the facility should be located as close as possible to the point of origin of the PCBs. The storage site should be as remote as possible from other activities carried out on the same premises, such as manufacturing and shipping. In all cases, the storage facility should be located to provide good traffic access for both transportation and fire-fighting vehicles.

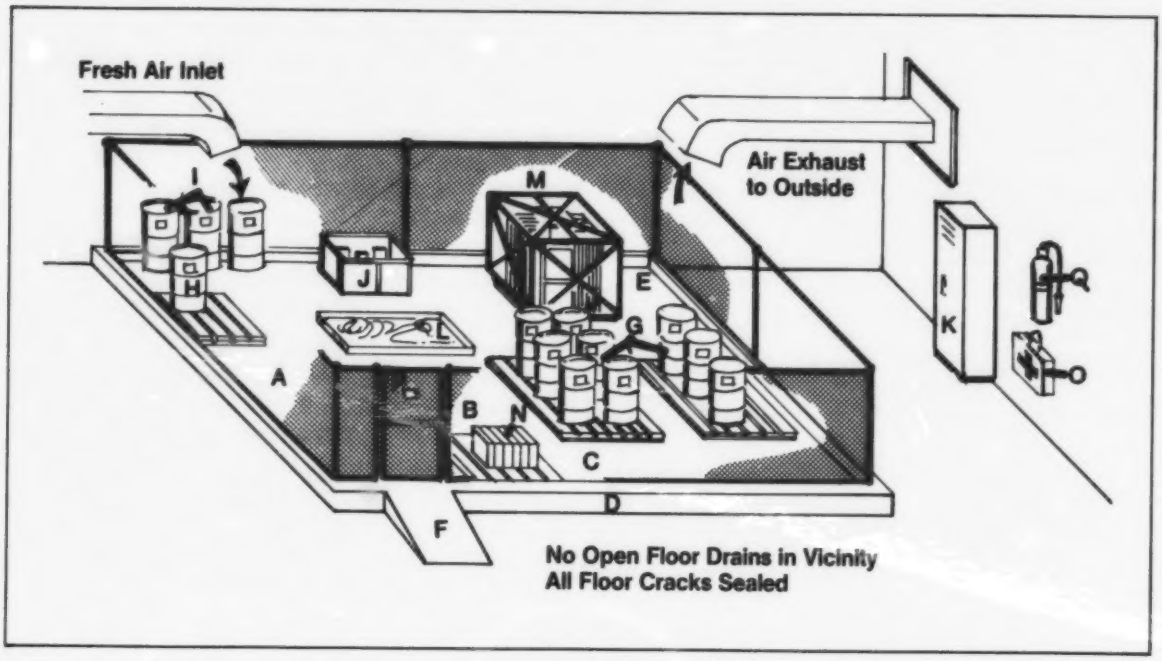
The requirements for handling and storing PCB-containing equipment vary from province to province. Prior to finalizing the siting and design of storage facilities, the reader should contact the appropriate provincial agency to obtain the current requirements. For additional information, the Environment Canada publication, "Manual for the Management of Wastes Containing Polychlorinated Biphenyls (PCBs)" (1987), should be consulted.

A qualified, experienced engineering team should be employed to design the storage facilities. An ideal indoor storage area is shown in Figure 15. Figure 16 depicts an ideal outdoor storage area for a de-energized transformer.

TABLE 14 SOME EXAMPLES OF PCBs IN STORAGE

New Equipment	i) Spare PCB capacitors ii) Spare PCB transformers iii) Spare mineral oil transformers contaminated with PCBs
Discarded Equipment	i) Used PCB capacitors ii) Scrapped PCB transformers iii) Other scrapped equipment that contains PCBs
PCBs and Contaminated Liquids	i) PCBs drained from electrical equipment ii) PCBs collected from drip pans and sumps serving PCB-containing electrical equipment iii) Solvents, mineral oil or other dielectric fluids contaminated with PCBs in a concentration exceeding 50 ppm
Contaminated Materials and Equipment	i) Earth, gravel, sorbents, plastic, wood, etc., contaminated with PCBs (e.g., from spills) ii) Clothing worn by workers cleaning up PCB spills or during maintenance of PCB equipment iii) Pumps, hoses, etc., used to transfer PCBs iv) Shovels, funnels and other tools used for PCB spill clean-up

FIGURE 15 IDEAL INDOOR STORAGE AREA



A – security fence (chain-link)

B – padlocked door

C – concrete floor (no drains)
- all cracks and expansion joints between slabs sealed with compound
- floor painted with epoxy paint to prevent PCBs from working their way through the concrete; Note: certain paints and compounds deteriorate in PCBs; check with the manufacturer

D – concrete curb around perimeter of storage area; inside of curb painted with epoxy

E – sealing compound (grouting) at corner of curb to prevent leakage under curb

F – ramp over concrete curb, into storage area

G – drums containing used PCBs, used capacitors, and contaminated materials
- stored on pallets for mobility

H – drum containing unused PCBs stored on pallets

I – spare drums

J – uncontaminated clean-up materials labelled stored in bin

K – locker for garments worn when working with PCBs

L – pumps and hoses for use with PCBs laid in an open pan to catch drips

M – scrapped transformer in protective crate

N – spare new capacitors stored on pallets

O – first-aid kit

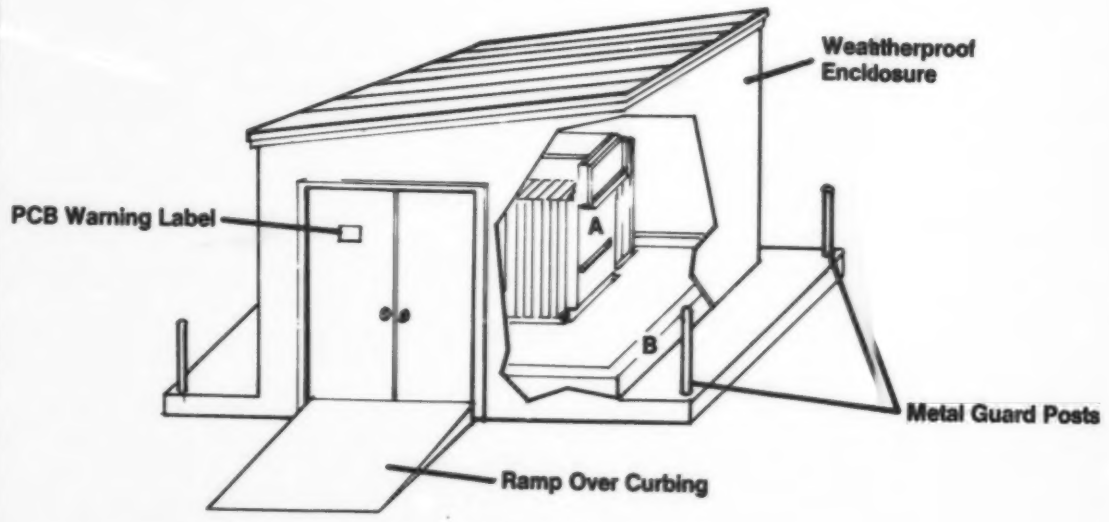
P – PCB label on door

Q – chemical or foam-type fire extinguisher

The main design features for storage facilities are:

i) siting must be in an area with a low risk of flooding;
ii) unserialized PCB labels in the 15 cm × 15 cm size (Figure 6) should be installed on the outside of any storage enclosures or building and on gates and doors leading to such areas;
iii) storage areas must be provided with external guard rails and bumper posts to prevent accidental traffic damage;
iv) sufficient space should be available for internal access (e.g., for fork truck and turning spaces);
v) equipment or containers shouldd not be stacked in the storage area unlless they are specifically designed to bbe stored this way;
vi) floors should be sloped to eitheer a sump or shallow floor drainage trenchh leading to a sump, and heavy-duty steeel traffic grating should be used over tthe trenches, which should be cleanable with aa shovel;
vii) drainage from the storage areaa should not be possible;
viii) concrete should be coated with a PCB-resistant protective coatinng (e.g., special epoxy); and
ix) smoke detectors should be instalalled.

FIGURE 16 IDEAL OUTDOOR STORAGE AREA FOR A DE-ENERGIZED TRANSFORMER



A – De-energized transformer mounted on concrete floor to keep it from shifting
B – Concrete curb to contain any leakage; floor and curb painted with a sealer resistant to PCBs and solvents.

If an outdoor area must be used, it should be covered in such a way that precipitation will be diverted from the storage area. Cost permitting, a sufficiently large sump or separate holding vessel should be provided so that any storm waste could be held and tested. If found to be uncontaminated, the storm waste could then be pumped to a receiving sewer or watercourse. All storage facilities should be protected against vandalism.

7.3 Maintenance Guidelines

7.3.1 General Precautions. The following guidelines should be followed for the safe and efficient maintenance of a storage area:

i) ensure that a knowledgeable individual is in charge of the storage area and that this person maintains accurate records for the facility and is trained in emergency response procedures;
ii) limit access to the storage area and keep doors locked;
iii) display emergency clean-up procedures and signs indicating that PCBs are in storage area;
iv) have clean-up material (sorbent, solvent) on hand;
v) keep first aid kit, protective clothing and self-contained breathing apparatus in a nearby, readily accessible locker;
vi) store PCBs in suitable containers and do not stack the containers unless they are designed to be stored this way;
vii) segregate PCBs as indicated in Table 14;
viii) ensure containers are properly painted to prevent rusting;
ix) place metal catch buckets under drain spouts on transformers and remove handles from valves; and
x) repair any damage to floors or replace leaky containers as required.

7.3.2 Fire Precautions. Company officials should notify municipal fire departments about the location and contents of storage facilities and ensure that they are knowledgeable in fighting fires involving PCBs. PCBs do not burn easily, but the vapours can be extremely irritating and hazardous to health; self-contained breathing apparatus and full protective clothing are required when fighting PCB fires. Foam or dry chemicals, *not* water, should be used to extinguish the fire. Protective clothing should be properly disposed of afterwards.

The clean-up following a fire must include the removal of PCB residues by solvent wiping from any surfaces that appear, or testing proves, to be contaminated. Clean-ups should be conducted as outlined in Chapter 5. All contaminated cleaning materials must be placed in drums and stored as PCB waste. Further details on precautionary measures for PCB fires can be found in the Environment Canada publication "Fires in Electrical Equipment Containing PCBs: Recommendations to Prevent Contamination by PCDFs" (1985).

7.3.3 Inspections and Record-keeping. PCB storage areas should be inspected on a regular basis; once a month, if possible. A log should be kept indicating inspection dates, the inspector's name and his remarks and recommendations. In the same log, PCB spills or leaks should be described along with the method used for clean-up and disposal.

Each piece of equipment or container placed in a storage area for disposal should be labelled in accordance with guidelines in the "Manual for the Management of Wastes Containing Polychlorinated Biphenyls (PCBs)". Records should also be kept of items taken out of or brought into the storage area (see Figure 17). Information kept should include:

i) date — the date materials are received or removed;
ii) description — a description of materials including nameplate description, serial numbers, PCB registration number and quantity;
iii) destination/source — an indication of the origin or destination of PCB goods;
iv) shipper or receiver — person(s) or companies sending PCB goods to the storage area and the name of the individual receiving and authorizing their storage;
v) storage code — for outgoing and incoming materials, an identification number indicating where the materials are stored in the storage area; and
vi) authorization and department — name and department of the person in charge of transfer of goods.

Finally, provincial environment ministries should be contacted to determine if provincial storage records are required.

FIGURE 17 PCB STORAGE RECORD

PCB STORAGE RECORD FOR: DRUMS, CAPACITORS, TRANSFORMERS, OTHER

Date						
Received	Removed	Description	Destination/ Source	Shipper or Receiver	Storage Code	Authorization & Department

REFERENCES

Environment Canada, Environmental Protection Service, "Fires in Electrical Equipment Containing PCBs: Recommendations to Prevent Contamination by PCDFs", prepared by Jean M. Carbonneau, from report by M.M. Dillon Limited and Wellington Environmental Consultants, Report EPS 1/CC/2, March 1985.

Environment Canada, "Identification of PCB-filled Fluorescent Lamp Ballasts", by Campbell McDonald and Robert Tourangeau, Environmental Protection Service, Report EPS 2/CC/2, 1986.

Environment Canada, Environmental Protection Service, "Manual for the Management Wastes Containing Polychlorinated Biphenyls (PCBs)", Report EPS 9/HA/1, 1987.

Environment Canada, EPS Ontario Region, "PCB Field Test Kit Evaluation", by Marcel De Bellefeuille, for Commercial Chemicals Branch, Manuscript TS-2, September 1985 (unpublished).

Environment Canada, Environmental Protection Service, "1982 Review of Substitutes for PCB in Transformers", by M.M.Dillon Limited, for the Contaminants Control Branch, Environmental Impact Control Directorate, Ottawa (unpublished).

Environment Canada, Pacific and Yukon Region, "PCB Handbook for the Management of Electrical Equipment and Wastes Containing Polychlorinated Biphenyls", by Stothert Engineering Ltd., for the Environmental Protection Service, Regional Program Report 79-19 (March 1979).

APPENDIX A
CHLOROBIPHENYL REGULATIONS

Registration
SOR/77-734 7 September, 1977

ENVIRONMENTAL CONTAMINANTS ACT

Chlorobiphenyl Regulations No. 1

P.C. 1977-2470 31 August, 1977

Whereas a copy of the proposed Regulation substantially in the form set out in the schedule hereto, was published in the *Canada Gazette* Part I on February 26, 1977;

And Whereas no notice of objection was filed with the Minister pursuant to subsection 5(3) of the Environmental Contaminants Act.

Therefore, His Excellency the Governor General in Council, on the recommendation of the Minister of Fisheries and the Environment and the Minister of National Health and Welfare, pursuant to paragraph 18(*c*) of the Environmental Contaminants Act, is pleased hereby to make the annexed Regulations prescribing certain uses in respect of which certain chlorobiphenyls may not be used.

REGULATIONS PRESCRIBING CERTAIN USES IN RESPECT OF WHICH CERTAIN CHLOROBIPHENYLS MAY NOT BE USED

Short Title

1. These Regulations may be cited as the *Chlorobiphenyl Regulations No. 1*.

Interpretation

2. In these Regulations,

"Act" means the *Environmental Contaminants Act*;

"chlorobiphenyls" means those chlorobiphenyls that have the molecular formula $C_{12}H_{10-n}Cl_n$ in which "n" is greater than 2;

"Minister" means the Minister of the Environment.

Prescription of Uses

3. For the purpose of subsection 8(2) of the Act, the following commercial, manufacturing and processing uses are hereby prescribed effective September 1, 1977, as uses in respect of which chlorobiphenyls may not be used:

(*a*) use in the operation, servicing or maintenance of any product, machinery or equipment other than

(i) electrical capacitors, electrical transformers and associated switchgear and machinery or equipment used to manufacture electrical capacitors, electrical transformers and associated switchgear,

(ii) heat transfer equipment, hydraulic equipment and vapour diffusion pumps that were designed to use

Enregistrement
DORS/77-734 7 septembre 1977

LOI SUR LES CONTAMINANTS DE L'ENVIRONNEMENT

Règlement sur les biphényles chlorés (n° 1)

C.P. 1977-2470 31 août 1977

Vu qu'une copie du Règlement proposé essentiellement dans la forme exposée à l'annexe ci-après a été publiée dans la *Gazette du Canada* (Partie I) le 26 février 1977;

Et vu qu'aucune objection n'a été formulée au ministre en vertu du paragraphe 5(3) de la Loi sur les contaminants de l'environnement.

A ces causes, sur avis conforme du ministre des Pêcheries et de l'Environnement ainsi que du ministre de la Santé nationale et du Bien-être social et en vertu de l'alinéa 18 *c*) de la Loi sur les contaminants de l'environnement, il plaît à Son Excellence le Gouverneur général en conseil de mettre en vigueur le Règlement ci-annexé interdisant certains emplois de certains biphényles chlorés.

RÈGLEMENT INTERDISANT CERTAINS EMPLOIS DE CERTAINS BIPHÉNYLES CHLORÉS

Titre abrégé

1. *Règlement sur les biphényles chlorés (n° 1).*

Définitions

2. On entend par

«biphényles chlorés» les byphényles dont la formule moléculaire est $C_{12}H_{10-n}Cl_n$ où «n» est plus grand que 2,

«loi» la *Loi sur les contaminants de l'environnement*,

«ministre» le ministre de l'Environnement.

Emplois interdits

3. Pour l'application du paragraphe 8(2) de la Loi, les emplois suivants des biphényles chlorés dans le commerce, la fabrication et la transformation sont interdits à compter du 1er septembre 1977:

a) les emplois dans l'exploitation, la réparation et l'entretien de tout produit, machinerie ou équipement sauf:

(i) les condensateurs électriques, les transformateurs électriques et l'appareillage connexe et la machinerie ou l'équipement servant à leur fabrication,

(ii) tout matériel de transfert de la chaleur, tout matériel hydraulique ou toute pompe à diffusion de vapeur utilisés au Canada avant le 1er mars 1977 et dont la conception exige l'emploi de biphényles chlorés et

chlorobiphenyls and were in use in Canada before March 1, 1977, and

(iii) machinery or equipment, the operation of which is intended to destroy the chemical structure of chlorobiphenyls; and

(*b*) use as a constituent of any machinery, equipment or product manufactured in or imported into Canada after September 1, 1977 other than electrical capacitors, electrical transformers and associated switchgear.

(iii) la machinerie ou l'équipement destinés à détruire la structure chimique des biphényles chlorés et

b) les emplois dans les produits, la machinerie ou l'équipement fabriqués ou importés au Canada après le 1er septembre 1977, sauf les condensateurs électriques, les transformateurs électriques et l'appareillage connexe.

Registration
SOR/80-461 20 June, 1980

ENVIRONMENTAL CONTAMINANTS ACT

Chlorobiphenyl Regulations No. 1, amendment

P.C. 1980-1637 19 June, 1980

Whereas a copy of a proposed amendment to Chlorobiphenyl Regulations No. 1 was published in the *Canada Gazette* Part I on December 2, 1978, pursuant to section 5 of the Environmental Contaminants Act;

Whereas two notices of objection to the proposed amendment were filed with the Minister of the Environment and an Environmental Contaminants Board of Review, established in accordance with section 6 of the Act, conducted an inquiry in accordance with that section;

Whereas on February 25, 1980, the Board submitted its report to the Minister of the Environment and to the Minister of National Health and Welfare together with its recommendations and all evidence that was before the Board in accordance with subsection 6(4) of the Act;

And Whereas the report of the Board was made public by a Press Release dated March 26, 1980 and at a press conference held on March 26, 1980.

Therefore, His Excellency the Governor General in Council, on the recommendation of the Minister of the Environment and the Minister of National Health and Welfare, and in accordance with the recommendations of the Environmental Contaminants Board of Review, pursuant to paragraph 18(*c*) of the Environmental Contaminants Act, is pleased hereby to amend the Chlorobiphenyl Regulations No. 1, C.R.C., c. 564, in accordance with the schedule hereto.

SCHEDULE

1. Section 2 of the *Chlorobiphenyl Regulations No. 1* is revoked and the following substituted therefor:

"2. In these Regulations,

"Act" means the *Environmental Contaminants Act*;

"chlorobiphenyls" means those chlorobiphenyls that have the molecular formula $C_{12}H_{10-n}Cl_n$ in which "n" is greater than 2;

"electrical transformers" includes transformer/rectifier assemblies installed in a common enclosure;

"Minister" means the Minister of the Environment."

Enregistrement
DORS/80-461 20 juin 1980

LOI SUR LES CONTAMINANTS DE L'ENVIRONNEMENT

Règlement n° 1 sur les biphényles chlorés—Modification

C.P. 1980-1637 19 juin 1980

Vu qu'une copie d'un projet de modification au Règlement n° 1 sur les biphényles chlorés a été publiée dans la *Gazette du Canada*, Partie I, le 2 décembre 1978, en vertu de l'article 5 de la Loi sur les contaminants de l'environnement;

Vu que deux avis d'opposition à ce projet de modification ont été déposés auprès du ministre de l'Environnement et qu'une Commission d'étude sur les contaminants de l'environnement établie en vertu de l'article 6 de la Loi a fait enquête aux termes de cet article;

Vu que le 25 février 1980, la Commission a présenté son rapport au ministre de l'Environnement et au ministre de la Santé nationale et du Bien-être social, ainsi que ses recommandations et l'ensemble de la preuve dont elle a pris connaissance, conformément au paragraphe 6(4) de la Loi;

Et vu que ledit rapport a été rendu public le 26 mars 1980 par communiqué et conférence de presse.

À ces causes, sur avis conforme du ministre de l'Environnement et du ministre de la Santé nationale et du Bien-être social, suivant les recommandations de la Commission et en vertu de l'alinéa 18*c*) de la Loi sur les contaminants de l'environnement, il plaît à Son Excellence le Gouverneur général en conseil de modifier, conformément à l'annexe ci-après, le Règlement n° 1 sur les biphényles chlorés, C.R.C., c. 564.

ANNEXE

1. L'article 2 du *Règlement n° 1 sur les biphényles chlorés* est abrogé et remplacé par ce qui suit:

«2. Dans le présent règlement,

«biphényles chlorés» désigne les composés de la formule moléculaire $C_{12}H_{10-n}Cl_n$ où «n» est plus grand que 2;

«Loi» désigne la *Loi sur les contaminants de l'environnement*;

«Ministre» désigne le ministre de l'Environnement;

«transformateurs électriques» comprend les ensembles transformateurs/redresseurs installés dans une même enceinte.»

2. Section 3 of the said Regulations is revoked and the following substituted therefor:

"3. For the purpose of subsection 8(2) of the Act, the following commercial, manufacturing or processing uses are hereby prescribed as uses in respect of which chlorobiphenyls may not be used:

(*a*) use in the operation of any product, machinery or equipment other than

(i) electrical capacitors, electrical transformers and associated electrical equipment,

(ii) heat transfer equipment, hydraulic equipment, electromagnets, and vapour diffusion pumps that were designed to use chlorobiphenyls and were in use in Canada before September 1, 1977, and

(iii) machinery or equipment, the operation of which is intended to destroy the chemical structure of chlorobiphenyls;

(*b*) use in the operation of electromagnets that are used to handle food, animal feed or anything intended to be added to food or animal feed for any purpose whatsoever;

(*c*) use as a constituent of any product, machinery or equipment manufactured in or imported into Canada after September 1, 1977, other than electrical capacitors, electrical transformers and associated electrical equipment;

(*d*) use as a constituent of electrical capacitors, electrical transformers and associated electrical equipment manufactured in or imported into Canada after July 1, 1980;

(*e*) use in the servicing or maintenance of any product, machinery or equipment, other than electromagnets, electrical transformers and associated electrical equipment; and

(*f*) use as new filling or as make-up fluid in the servicing or maintenance of any electromagnet, electrical transformer or associated electrical equipment."

3. Sections 1 and 2 shall come into force on July 1, 1980.

2. L'article 3 dudit règlement est abrogé et remplacé par ce qui suit:

«3. Aux fins du paragraphe 8(2) de la Loi, les emplois suivants des biphényles chlorés dans le commerce, la fabrication ou la transformation sont interdits:

a) l'emploi dans l'exploitation de tout produit, machinerie ou équipement, sauf

(i) les condensateurs électriques, les transformateurs électriques et l'équipement électrique connexe,

(ii) l'équipement de transfert de la chaleur, l'équipement hydraulique, les électro-aimants et les pompes à diffusion de vapeur conçus pour utiliser des biphényles chlorés et mis en service au Canada avant le 1er septembre 1977, et

(iii) la machinerie ou l'équipement destinés à détruire la structure chimique des biphényles chlorés;

b) l'emploi dans l'exploitation d'électro-aimants utilisés pour la manutention d'aliments destinés à l'homme ou aux animaux ou de leurs additifs;

c) l'emploi dans les produits, la machinerie ou l'équipement fabriqués ou importés au Canada après le 1er septembre 1977, sauf les condensateurs électriques, les transformateurs électriques et l'équipement électrique connexe;

d) l'emploi dans les condensateurs électriques, les transformateurs électriques et l'équipement électrique connexe fabriqués ou importés au Canada après le 1er juillet 1980;

e) l'emploi pour la réparation ou l'entretien des produits, de la machinerie ou de l'équipement autres que les électro-aimants, les transformateurs électriques et l'équipement électrique connexe; et

f) l'emploi comme nouveau fluide de remplissage ou comme fluide d'appoint pour la réparation ou l'entretien des électro-aimants, des transformateurs électriques ou de l'équipement électrique connexe.»

3. Les articles 1 et 2 entrent en vigueur le 1er juillet 1980.

EXPLANATORY NOTE

(This note is not part of the Regulation, but is intended only for information purposes.)

These amendments now have the following effects:

(1) The use of chlorobiphenyls is restricted to use in those items listed in subparagraphs 3(*a*)(i), (ii) and (iii).

(2) Paragraph 3(*b*) prohibits the use of chlorobiphenyls in the operation of electromagnets that are used to handle food, animal feed or anything intended to be added to food or animal feed for any purpose whatsoever.

(3) Paragraph 3(*c*) prohibits the use of chlorobiphenyls as a constituent of any product manufactured in or imported into Canada after September 1, 1977, other than electrical capacitors, electrical transformers and associated electrical equipment.

(4) Subsection 3(*d*) removes, effective July 1, 1980, the exemption regarding electrical capacitors, electrical transformers and associated electrical equipment so that thereafter the use of chlorobiphenyls is totally prohibited as a constituent of any product, machinery or equipment manufactured in or imported into Canada.

(5) Paragraph 3(*e*) allows the use of chlorobiphenyls after July 1, 1980 in the servicing or maintenance of electromagnets, electrical transformers and associated electrical equipment. This means, for example, that existing chlorobiphenyls may be removed, filtered and returned to the same piece of equipment. However, in paragraph 3(*f*) the use of additional chlorobiphenyls as a new filling or as make-up in servicing or maintenance is prohibited. This does not, though, prohibit the use of a suitable non-chlorobiphenyl fluid as a new filling or as make-up.

NOTE EXPLICATIVE

(La présente note ne fait pas partie du règlement et n'est publiée qu'à titre d'information.)

Ces modifications qui entrent en vigueur le 1er juillet 1980 visent:

(1) à limiter l'emploi de biphényles chlorés dans l'exploitation de tout produit, machinerie ou équipement sauf certains articles;

(2) à interdire leur emploi dans les électro-aimants utilisés pour la manutention dans l'industrie alimentaire;

(3) à interdire leur emploi dans les produits fabriqués ou importés au Canada après le 1er septembre 1977, sauf les condensateurs électriques, les transformateurs électriques et l'équipement électrique connexe;

(4) à ne plus exempter les articles visés au paragraphe (3) de la présente note;

(5) à interdire leur emploi pour la réparation ou l'entretien des produits de la machinerie ou de l'équipement sauf certains articles;

(6) à interdire leur emploi comme nouveau fluide de remplissage ou comme fluide d'appoint pour la réparation ou l'entretien de certains articles.

Registration
SOR/85-406 2 May, 1985

ENVIRONMENTAL CONTAMINANTS ACT

Chlorobiphenyl Regulations No. 2 (Product)

P.C. 1985-1473 2 May, 1985

Whereas a copy of the proposed regulations substantially in the form set out in the schedule hereto was published in the *Canada Gazette* Part I on January 21, 1984;

And Whereas the two notices of objection to the proposed regulations that were filed with the Minister pursuant to subsection 5(3) of the Environmental Contaminants Act were subsequently withdrawn,

Therefore, Her Excellency the Governor General in Council, on the recommendation of the Minister of the Environment and the Minister of National Health and Welfare, pursuant to paragraph 18(*e*) of the Environmental Contaminants Act*, is pleased hereby to make the annexed Regulations prescribing the maximum concentration of chlorobiphenyls that may be contained in certain products, effective August 1, 1985.

REGULATIONS PRESCRIBING THE MAXIMUM CONCENTRATION OF CHLOROBIPHENYLS THAT MAY BE CONTAINED IN CERTAIN PRODUCTS

Short Title

1. This Regulation may be cited as the *Chlorobiphenyl Regulations No. 2 (Product)*.

Interpretation

2. In these Regulations,

"Act" means the *Environmental Contaminants Act*;

"electrical transformer" includes a rectifier-transformer assembly installed in a common enclosure.

Prescription

3. (1) For the purpose of subsection 8(4) of the Act, the maximum concentration prescribed in respect of chlorobiphenyls contained in a product that is

(*a*) an electrical capacitor,

(*b*) an electrical transformer and its associated electrical equipment,

(*c*) an electro-magnet,

(*d*) heat transfer equipment,

(*e*) hydraulic equipment, or

(*f*) a vapour diffusion pump

* S.C. 1974-75-76, c. 72

Enregistrement
DORS/85-406 2 mai 1985

LOI SUR LES CONTAMINANTS DE L'ENVIRONNEMENT

Règlement n° 2 sur les biphényles chlorés (produits)

C.P. 1985-1473 2 mai 1985

Vu qu'une copie du projet de règlement essentiellement dans la forme exposée à l'annexe ci-après a été publiée dans la *Gazette du Canada*, Partie I, le 21 janvier 1984;

Et vu que les deux avis d'opposition au projet de règlement qui ont été déposés auprès du ministre de l'Environnement conformément au paragraphe 5(3) de la Loi sur les contaminants de l'environnement ont été retirés,

À ces causes, sur avis conforme du ministre de l'Environnement et du ministre de la Santé nationale et du Bien-être social et en vertu de l'alinéa 18*e*) de la Loi sur les contaminants de l'environnement*, il plaît à Son Excellence le Gouverneur général en conseil de prendre, à compter du 1er août 1985, le Règlement prescrivant la concentration maximale de biphényles chlorés dans certains produits, ci-après.

RÈGLEMENT PRESCRIVANT LA CONCENTRATION MAXIMALE DE BIPHÉNYLES CHLORÉS DANS CERTAINS PRODUITS

Titre abrégé

1. Le présent règlement peut être cité sous le titre: *Règlement n° 2 sur les biphényles chlorés (produits)*.

Définitions

2. Dans le présent règlement,

«Loi» désigne la *Loi sur les contaminants de l'environnement*;

«transformateur électrique» comprend un ensemble transformateur-redresseur installé dans une même enceinte.

Concentration prescrite

3. (1) Aux fins du paragraphe 8(4) de la Loi, la concentration maximale prescrite de biphényles chlorés dans

a) un condensateur électrique,

b) un transformateur électrique et l'équipement électrique connexe,

c) un électro-aimant,

d) l'équipement de transport de la chaleur,

e) l'équipement hydraulique, ou

f) une pompe à diffusion de vapeur,

* S.C. 1974-75-76, c. 72

designed to use chlorobiphenyls, is 50 parts per million by weight of the liquid therein.

(2) Subsection (1) does not apply to the concentration of chlorobiphenyls in a product referred to in paragraphs (1)(*a*) to (*f*) that is

(*a*) offered for sale as a necessary and integral part of an immovable building, plant or structure that is offered for sale;

(*b*) imported for destruction of the chemical structure of the chlorobiphenyls contained therein; or

(*c*) offered for sale for destruction or storage awaiting destruction of the chemical structure of the chlorobiphenyls contained therein.

EXPLANATORY NOTE

(This note is not part of the Regulation, but is intended only for information purposes.)

These Regulations prescribe the maximum concentration of chlorobiphenyls that may be contained in the listed products at the time they are imported, manufactured or knowingly offered for sale.

conçus pour utiliser des biphényles chlorés, est de 50 parties par million, en poids, du liquide s'y trouvant.

(2) Le paragraphe (1) ne s'applique pas aux produits visés aux alinéas (1)*a*) à *f*) qui sont

a) mis en vente en tant que partie essentielle ou intégrante d'un immeuble, d'une installation ou d'une structure non déplaçables mis en vente;

b) importés pour fins de destruction de la structure chimique des biphényles chlorés qui y sont contenus; ou

c) mis en vente pour fins de destruction ou d'entreposage en attente de la destruction de la structure chimique des biphényles chlorés qui y sont contenus.

NOTE EXPLICATIVE

(La présente note ne fait pas partie du règlement et n'est publiée qu'à titre d'information.)

Le règlement prescrit la concentration maximale de biphényles chlorés qui est permise dans certains produits au moment où ils sont importés, fabriqués ou sciemment mis en vente.

Registration
SOR/85-407 2 May, 1985

ENVIRONMENTAL CONTAMINANTS ACT

Chlorobiphenyl Regulations No. 3 (Release)

P.C. 1985-1472 2 May, 1985

Whereas a copy of the proposed regulations substantially in the form set out in the schedule hereto was published in the *Canada Gazette* Part I on January 21, 1984;

And Whereas the two notices of objection to the proposed regulations that were filed with the Minister pursuant to subsection 5(3) of the Environmental Contaminants Act were subsequently withdrawn,

Therefore, Her Excellency the Governor General in Council, on the recommendation of the Minister of the Environment and the Minister of National Health and Welfare, pursuant to paragraph 18(*a*) of the Environmental Contaminants Act*, is pleased hereby to make the annexed Regulations prescribing the maximum concentration and quantity of chlorobiphenyls that may be released into the environment, effective August 1, 1985

REGULATIONS PRESCRIBING THE MAXIMUM CONCENTRATION AND QUANTITY OF CHLOROBIPHENYLS THAT MAY BE RELEASED INTO THE ENVIRONMENT

Short Title

1. These Regulations may be cited as the *Chlorobiphenyl Regulations No. 3 (Release)*.

Interpretation

2. In these Regulations,

"Act" means the *Environmental Contaminants Act*;

"electrical transformers" includes rectifier-transformer assemblies installed in a common enclosure;

"package" means any receptacle or enveloping material that contains any of the equipment referred to in section 4.

Maximum Concentration

3. For the purposes of subsection 8(1) of the Act, the maximum concentration of chlorobiphenyls that may be released into the environment in any geographical area of Canada, other than any water or place to which subsection 33(2) of the *Fisheries Act* applies, in the course of

(*a*) a commercial, manufacturing or processing activity, other than

(i) an application to a road surface, or

* S.C. 1974-75-76, c. 72

Enregistrement
DORS/85-407 2 mai 1985

LOI SUR LES CONTAMINANTS DE L'ENVIRONNEMENT

Règlement n° 3 sur les biphényles chlorés (rejets)

C.P. 1985-1472 2 mai 1985

Vu qu'une copie du règlement proposé essentiellement dans la forme exposée à l'annexe ci-après a été publiée dans la *Gazette du Canada*, Partie I, le 21 janvier 1984;

Et vu que les deux avis d'opposition au projet de règlement qui ont été déposés auprès du ministre de l'Environnement conformément au paragraphe 5(3) de la Loi sur les contaminants de l'environnement ont été retirés,

À ces causes, sur avis conforme du ministre de l'Environnement et du ministre de la Santé nationale et du Bien-être social et en vertu de l'alinéa 18*a*) de la Loi sur les contaminants de l'environnement il plaît à Son Excellence le Gouverneur général en conseil de prendre, à compter du 1er août 1985, le Règlement fixant la concentration et la quantité maximales de biphényles chlorés qui peuvent être rejetés dans l'environnement, ci-après

RÈGLEMENT FIXANT LA CONCENTRATION ET LA QUANTITÉ MAXIMALES DE BIPHÉNYLES CHLORÉS QUI PEUVENT ÊTRE REJETÉS DANS L'ENVIRONNEMENT

Titre abrégé

1. Le présent règlement peut être cité sous le titre: *Règlement n° 3 sur les biphényles chlorés (rejets)*.

Définitions

2. Dans le présent règlement,

«emballage» désigne un contenant ou un matériau servant à envelopper les pièces d'équipement visées à l'article 4;

«Loi» désigne la *Loi sur les contaminants de l'environnement*;

«transformateur électrique» comprend un ensemble transformateur-redresseur installé dans une même enceinte.

Concentration prescrite

3. Aux fins du paragraphe 8(1) de la Loi, la concentration maximale de biphényles chlorés que toute personne peut rejeter ou permettre de rejeter dans l'environnement dans une région du Canada, sauf les eaux ou les lieux visés au paragraphe 33(2) de la *Loi sur les pêcheries*,

a) dans le cadre d'une opération commerciale, de fabrication ou de traitement, autre

(i) qu'un traitement de surface d'une route, ou

* S.C. 1974-75-76, c. 72

(ii) an activity described in section 4

is 50 parts per million by weight; and

(*b*) an application to a road surface, is five parts per million by weight.

Maximum Quantity

4. For the purposes of subsection 8(1) of the Act, the maximum quantity of chlorobiphenyls that may be released into the environment in any geographical area of Canada, other than any water or place to which subsection 33(2) of the *Fisheries Act* applies, in the course of the operation, servicing, maintenance, decommissioning, transportation or storage of

(*a*) electrical transformers and associated electrical equipment manufactured in or imported into Canada before July 1, 1980,

(*b*) electro-magnets designed to use chlorobiphenyls and manufactured in or imported into Canada before September 1, 1977,

(*c*) electrical capacitors manufactured in or imported into Canada before July 1, 1980, or

(*d*) heat transfer equipment, hydraulic equipment or vapour diffusion pumps designed to use chlorobiphenyls and in use in Canada before September 1, 1977,

is 1 g per day

(*e*) for any one piece of equipment, or

(*f*) for any one package of equipment.

EXPLANATORY NOTE

(This note is not part of the Regulation, but is intended only for information purposes.)

These Regulations prescribe the maximum concentration and quantity of chlorobiphenyls that may be released into the environment in the prescribed geographical area of Canada in the course of commercial, manufacturing and processing activities.

(ii) qu'une opération visée à l'article 4,

est de 50 parties par million, en poids, et

b) au cours d'un traitement de surface d'une route, est de cinq parties par million en poids.

Quantité maximale

4. Aux fins du paragraphe 8(1) de la Loi, la quantité maximale de biphényles chlorés qui peut être rejetée dans l'environnement dans une région du Canada, sauf les eaux ou les lieux visés au paragraphe 33(2) de la *Loi sur les pêcheries*, au cours de l'exploitation, de l'entretien, de la réparation, de la mise hors service, du transport ou de l'entreposage

a) d'un transformateur électrique et de l'équipement électrique connexe, fabriqués ou importés au Canada avant le 1er juillet 1980,

b) d'un électro-aimant conçu pour utiliser des biphényles chlorés et fabriqué ou importé au Canada avant le 1er septembre 1977,

c) d'un condensateur électrique fabriqué ou importé au Canada avant le 1er juillet 1980, ou

d) de l'équipement de transfert de la chaleur, de l'équipement hydraulique ou d'une pompe à diffusion de vapeur conçus pour utiliser des biphényles chlorés et utilisés au Canada avant le 1er septembre 1977,

est de 1 g par jour

e) pour chaque pièce d'équipement, ou

f) pour chaque emballage d'équipement.

NOTE EXPLICATIVE

(La présente note ne fait pas partie du règlement et n'est publiée qu'à titre d'information.)

Le règlement prescrit la quantité et la concentration maximales de biphényles chlorés que toute personne peut délibérément rejeter ou permettre de rejeter dans l'environnement à certains endroits au Canada, au cours d'opérations commerciales, de fabrication et de traitement.

APPENDIX B
ENVIRONMENT CANADA AND PROVINCIAL ENVIRONMENT MINISTRY OFFICES

ENVIRONMENT CANADA OFFICES

Headquarters

	Commercial Chemicals Branch Conservation and Protection Environment Canada Place Vincent Massey — 14th Floor Ottawa, Ontario K1A 0H3	Office - (819) 997-1640

Regional Offices

Atlantic	5th Floor, Queen Square 45 Alderney Drive Dartmouth, N.S. B2Y 2N6	Office - (902) 426-6141 Emergency - (902) 426-6200* Newfoundland (709) 772-5488*
Quebec	1179 Bleury Street Montreal, Quebec H3B 3H9	Office - (514) 283-4670 Emergency - (514) 283-2333*
Ontario	7th Floor 25 St. Clair Avenue East Toronto, Ontario M4T 1M2	Office - (416) 973-5840 Emergency - (416) 346-1971*
Western and Northern	Twin Atria No.2, 2nd Floor 4999 — 98th Avenue Edmonton, Alberta T6B 2X3	Office - (403) 468-8026 Emergency - (403) 468-8020*
Pacific/Yukon	Kapilano 100 Park Royal South West Vancouver, B.C. V7T 1A2	Office - (604) 666-2588 Emergency - (604) 666-6100*

* 24 hour service

Branch and District Offices

Atlantic	Newfoundland District Office P.O. Box 5037 St. John's, Nfld. A1C 5V3	(709) 772-5488
	New Brunswick District Office 364 Argyle Street Fredericton, N.B. E3B 4Z9	(506) 452-3286

Branch and District Offices

Atlantic	Nova Scotia District Office P.O. Box 2107 5151 Terminal Road, 4th Floor Halifax, N.S. B3J 3B7	(902) 426-5601
	Prince Edward Island District Office Room 308, Dominion Building Charlottetown, P.E.I. C1A 4A9	(902) 566-7042
Ontario	Ottawa District Office River Road Laboratories River Road Ottawa, Ontario K1A 1C8	(613) 998-8830
Western and Northern	Alberta District Office Twin Atria No. 2, 2nd Floor 4999 — 98 Avenue Edmonton, Alberta T6B 2X3	(403) 468-8001
	Saskatchewan District Office 1901 Victoria Avenue, 2nd Floor Regina, Saskatchewan S4P 3R4	(306) 780-6464
	Manitoba District Office 800 Kensington Building 275 Portage Avenue Winnipeg, Manitoba R3B 2B3	(204) 949-2961
	Northwest Territories District Office Bellanca Building, 9th Floor Box 370 Yellowknife, N.W.T. X1A 2N3	(403) 873-3456
Pacific and Yukon	Yukon Branch Office Federal Building, Room 225 Whitehorse, Yukon Y1A 2B5	(403) 667-3400

PROVINCIAL ENVIRONMENT MINISTRY OFFICES

Nova Scotia	Nova Scotia Department of the Environment Assessment Division 5151 Terminal Road P.O. Box 2107 Halifax, N.S. B3J 3B7	(902) 424-5300
New Brunswick	Department of Municipal Affairs and Environment Environmental Protection Branch P.O. Box 6000 364 Argyle St. Fredericton, N.B. E3B 5H1	(506) 453-2861
Newfoundland	Department of Environment Elizabeth Towers 100 Elizabeth Avenue P.O. Box 4750 St. John's, Nfld. A1C 5T7	(709) 576-2557
Prince Edward Island	Department of Community and Cultural Affairs Environment Division P.O. Box 2000 11 Kent St. Charlottetown, P.E.I. C1A 7N8	(902) 892-0311
Quebec	Environment Quebec Dangerous Substances Directorate 3900 Marly St. P.O. Box 34 St. Foy, P.Q. G1X 4E4	(418) 644-3420

Ontario	Ministry of the Environment Waste Management Division 40 St. Clair West — 5th floor Toronto, Ont. M4V 1P5	(416) 323-5200
Manitoba	Department of Environment Waste Management Division 139 Tuxedo Ave., Bldg. 2 P.O. Box 7 Winnipeg, Man. R3N 0H6	(204) 945-7083
Saskatchewan	Saskatchewan Environment Waste Management Division 3085 Albert St. Regina, Sask. S4S 0B1	(306) 787-5811
Alberta	Alberta Environment Waste Management Division 9820 106th St. — 4th floor Edmonton, Alta. T5K 2J6	(403) 427-5868
British Columbia	Ministry of the Environment Waste Management Branch 810 Blanshard St. Victoria, B.C. V8V 1X5	(604) 387-9953
Yukon	Department of Community and Transportation Services P.O. Box 2703 Whitehorse, Yukon Y1A 2C6	(403) 667-3032
N.W.T.	Department of Renewable Resources Yellowknife, N.W.T. X1A 2L9	(403) 873-7654